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NATIONAL DAM SAFETY PROGRAM. DUCK CREEK - STATE WILDLIFE REFUGE--ETC(U)
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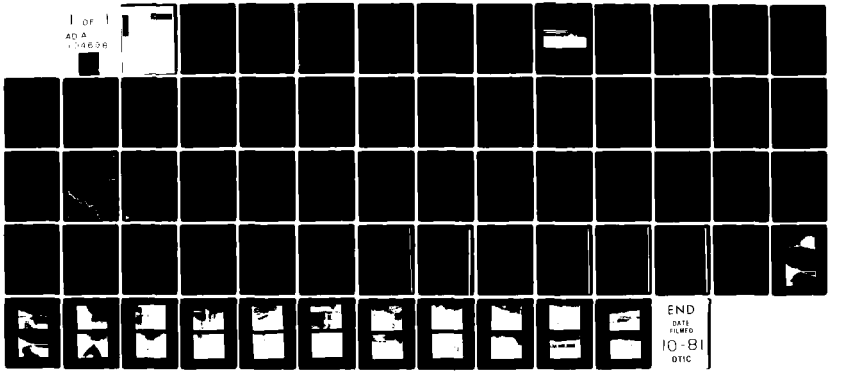

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DUCK CREEK
STATE WILDLIFE REFUGE - POND 1
BOLLINGER AND STODDARD COUNTIES, MISSOURI
MISSOURI INVENTORY NO. 40063

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Duck Creek - State Wildlife Refuge - Pond 1 (MO 40063), Lower Mississippi - St. Francis Basin, Bollinger and Stoddard Counties, Missouri. Phase I Inspection Report.

"Original contains color plates: All DTIC reproductions will be in black and white"

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI
MAR 1980

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PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Duck Creek State Wildlife Refuge - Pond 1
State Located	Missouri
County Location	Bollinger and Stoddard Counties
Stream	Castor River
Date of Inspection	22 May 1979

The Duck Creek State Wildlife Refuge - Pond 1 was inspected by an interdisciplinary team of engineers from the Memphis District, U. S. Army Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. Failure could threaten the life and property of approximately 5 families at Idlewild, MO and 10 families at Kinder, MO as well as endanger traffic and disrupt transportation on Highway 51 immediately south of the Refuge.

The inspection and evaluation indicate that the discharge system is adequate to meet the criteria set forth in the guidelines for a dam having the above mentioned size classification and hazard potential. According to the guidelines, the discharge system is required to pass the Probable Maximum Flood (PMF) without the dam embankment being overtopped. The PMF is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. The discharge structures for Duck Creek will not pass the PMF nor the one-half PMF without overtopping. The PMF and one-half PMF will overtop the northern portion of the levee, however, no downstream hazard should result from this overtopping since the overtopped levee is only about 1.5 ft. as shown by levee section "L" on Plate 5. The PMF and one-half PMF will overtop the levee an average of about 1 ft. and less than 0.5 ft., respectively. If the levee failed, the floodwave immediately downstream of the levee would be about 1.5 ft. and 1 ft. for the PMF and one-half PMF, respectively. During these floods, the water surface on the landside of the levee would more than likely be equal to that on the lakeside. The worst condition would be if the landside were dry, the storm occurred over the lake, and the northern levee was overtopped. But even for this situation, the 1.5 - to 1 -ft. high flood wave would not present a hazard to loss of life for the residences of Idlewild and Kinder, Missouri, which are about 3 to 4 miles downstream of the northern levee. Also the discharge structures will pass the 100-year flood without overtopping, which is a flood that has a 1 percent chance of being exceeded in any given year.

A deficiency visually observed was the abundance of trees and small brush growth on the landside slope. Another deficiency found was the lack of seepage and stability analysis records.

It is recommended that the owner take action to correct or control the deficiencies described. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design and construction of dams.

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SUBMITTED BY: SIGNED
Chief, Engineering Division
23 JUL 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
25 JUL 1980
Date

Overview of Lake

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
DUCK CREEK STATE WILDLIFE REFUGE - POND 1 - ID. NO. 40063

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer for the St. Louis District, Corps of Engineers, directed that a safety inspection of the Duck Creek State Wildlife Refuge - Pond 1 be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is a unique structure as its consists of a U-shaped levee-type fill which was erected on an almost flat plain with a slight dip to the south. The topography adajacent to the levee is relatively flat to rolling. Mingo Swamp extends in a southwesterly direction from the levee. Soils in the area underlying the dam and the lake are composed of sands, silts, and clays. Topography in the vicinity of the dam is shown on Plate 2.

(2) The primary means of discharge is a 42 inch CMP in the southwest corner of Pond 1. However, 2 - 36" CMPs which are normally used to fill the adjacent ponds during duck season can also be used to control the water level in Pond No. 1. Also a double 6 foot x 5 foot concrete sluice and gate structure which normally controls inflow to the reservoir could be used as an outlet structure during periods of high water within the reservoir. A low area in the top of the levee near the northwest corner of the levee system can serve as an emergency spillway.

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the southwestern portion of Bollinger County and northern portion of Stoddard County, Missouri, as shown on Plate 1. The lake formed by the levee as shown on Plate 2 is located on the Sturdivant, Missouri Quadrangle sheet in Section 5; Township 27 North; Range 9 East and Sections 30 and 31; Township 28 North; Range 9 East.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1 c above. Based on these criteria, this dam is in the intermediate size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in a High Hazard Classification.

e. Ownership. The dam is owned by the Missouri Department of Conservation, P. O. Box 180, Jefferson City, MO 65102.

f. Purpose of Dam. The dam forms a 1960 - acre wildlife refuge and recreational lake.

g. Design and Construction History. The dam was designed by the Missouri Department of Conservation in 1951 and 1952 (then known as Missouri Conservation Commission). The plans and drawings consist of extensive details for the entire Duck Creek State Wildlife Refuge which incorporates the plans and drawings for Pond 1. The plans of interest for Pond 1 consist of typical cross-section profiles at each culvert and at the concrete sluice gate. The dam was built in 1953 by the Missouri Department of Conservation. Construction equipment reportedly used were tractors, dozers, graders, and scrapers. The type of compaction equipment used is unknown. The borrow material came from the areas adjacent to the levee system. The borrow material consisted of native sands, silts, and clays. Riprap has been placed abundantly on the lake side of the levee to impede erosion and wave wash.

The embankment was designed with a 22 foot crown width and the field survey shows that the crown width varies from a minimum of 14 feet at the northern end to a maximum of 40 feet along the eastern edge with a typical crown width of 22 feet. The design crown elevation for Pond 1 was 349.0 N.G.V.D. However, the field survey indicated that the crown elevations varied from a minimum of 346.1 N.G.V.D. at a low point in the northwestern corner to a maximum of 349.5 N.G.V.D. along the southern and western boundary. However, the levee crown elevation was greater than 348.0 N.G.V.D. except for an area of limited extent along the northern and northeastern boundary (see Plate 4). The plans indicate that the lakeside embankment slopes were designed at 1V on 3H and the landside embankment slopes were primarily 1V on 2H. The field survey indicates an average slope of 1V on 3.45H for lakeside and 1V on 2.9H for landside (see Plate 5).

The plans show the location of 3 culverts and a sluice gate for controlling the lake level. The culvert at Section "B" (Sta 18+04) was designed as a 36-inch CMP -72 feet long with an inlet invert elevation of 339.0 N.G.V.D. However the field survey indicates a 36 inch CMP - 61 feet long with an invert elevation of 339.2 N.G.V.D. The discharge is controlled by a slide gate water control structure whose top elevation is 347.1 N.G.V.D. The design elevation for the top of the control structure was 347.0 N.G.V.D. The purpose of this culvert is to fill Pond 3 when needed. The culvert at Section "E" (Sta 65+43) was not surveyed by the inspection team. Information obtained later indicated that the culvert was installed as a 42-inch CMP with an invert elevation of 336.0 N.G.V.D., which corresponds to the design information. The design called for 90 feet of 42-inch CMP pipe with an invert elevation of 336.0 N.G.V.D. The primary purpose of the culvert is to control the lake level by discharge into Ditch 1 which runs parallel to the western boundary of Pond 1. The culvert at Section "Q" (Sta 350+77) was designed as a 36-inch CMP - 214 feet long with an additional 3 feet for the slide gate water control structure. The design invert elevation was 341.5 N.G.V.D. and the top of the slide gate water control

structure was 347.0 N.G.V.D. The field survey indicates that a 36-inch CMP was installed with a length of 218 feet which includes the width of the water control structure. The invert elevation was determined to be 340.4 N.G.V.D. and the top of the slide gate water control structure was 347.2 N.G.V.D. The primary purpose of this culvert was to fill Pond 2.

A sluice gate is located at Section "H" (Sta 134+63) and is primarily used to control inflow to Pond 1 from Ditch 1. The design invert elevation was 341.0 N.G.V.D. The field survey indicated an invert elevation of 340.7 N.G.V.D. The total width of the sluice gate opening was measured to be 14.6 feet as indicated by a design of 14 feet 7 inches or 14.6 feet. The effective opening of each gate is 6 feet wide by 5 feet deep. The water level is controlled by two Hardesty steel gates (72" x 60"). The top of roadway across the intake structure was at an elevation of 349.73 N.G.V.D., while the design called for an elevation of 350.0 N.G.V.D.

h. Normal Operating Procedure. Normal rainfall, evaporation and the water level control structures all combine to maintain a relatively stable water surface. A drainage area of 1960 acres is entirely enclosed within the levee. The normal recreation pool is at 345.5 N.G.V.D. Some inflows can be obtained from Ditch 1 by closing a radial arm control structure on Ditch 1 and allowing the flow in Ditch 1 to be diverted through the sluice gate structure at Section "H" into the lake. The culverts at Section "B" and "Q" are used primarily to fill Ponds 3 and 2, respectively, during the duck season. The culvert at Section "E" is primarily used to control the water level within the lake. However, during periods of excessive rainfall all gates can be opened to regulate the lake level. It was reported that the lake level could be dropped 1/10 foot per day. However, it was not indicated under what combination of gate and culvert openings this applied. The levee was reported to have never been overtopped.

1.3 PERTINENT DATA

a. Drainage Area. 1960 acres (enclosed within levee system).

b. Discharge at Damsite.

(1) Discharge can take place through 3 CMP culverts, a double 6' x 5' sluice gate, and a low area along top of levee.

(2) Estimated experienced maximum flood at damsite - unknown.

c. Elevation. (Feet above N.G.V.D.)

(1) Observed Pool - 345.6

(2) Normal Pool - 345.5

(3) Spillway Crest - 346.1 (Low point in top of levee)

(4) Maximum Experienced Pool - unknown

(5) Top of Dam - Southern Boundary - 349.0
Eastern Boundary - 348.0

(6) Maximum Pool (PMF) - 347.28

(7) Discharge Structures - Inlet Inverts

Sluice gate - 340.7
Culverts:

Sta 18+04 - 339.2

Sta 65+43 - 336.0

Sta 350+77 - 340.4

(8) Streambed at Centerline - N/A

(9) Maximum Tailwater - Unknown

d. Reservoir. Length of maximum pool - 15600 ± feet.

e. Storage (Acre-feet).

(1) Observed Pool - 7687

(2) Normal Pool - 7500

(3) Spillway Crest - 8625

(4) Top of Dam - Southern Boundary - 14248
- Eastern Boundary - 12290

(5) Maximum Pool (PMF) - 10891

f. Reservoir Surface (Acres)

(1) Observed Pool - 1853

(2) Normal Pool - 1842

(3) Spillway Crest - 1900

(4) Maximum Experienced Pool - unknown

(5) Top of Dam - Southern Boundary - 1960
- Eastern Boundary - 1955

(6) Maximum Pool (PMF) - 1936

g. Dam.

(1) Type - earthen embankment

(2) Length - 40847 feet

(3) Height - 9.5 ± (Avg at southern edge)

(4) Top width - 22 feet (average)

(5) Side Slopes -

(a) Landside - 1V on 2.9H

(b) Lakeside - 1V on 3.45H

(6) Zoning - none

(7) Impervious Core - none

(8) Cutoff - none

(9) Grout Curtain - none

h. Diversion and Regulating Tunnel. None

i. Primary Discharge System.

(1) Culverts -

(a) Sta 18+04

(i) Type - A slide gate controlled 36 inch diameter CMP

(ii) Length - 61 feet

(iii) Inlet Invert -339.21 N.G.V.D.

(iv) Outlet Invert -339.17 N.G.V.D.

(b) Sta 65+43

(i) Type - A slide gate controlled 42 inch diameter CMP

(ii) Length - 90 feet (design)

(iii) Inlet Invert - 336.0 N.G.V.D. (design)

(iv) Outlet Invert - 332.0 N.G.V.D. (design)

(c) Sta 350+77

(i) Type - A slide gate controlled 36-inch diameter CMP

(ii) Length - 218 feet

(iii) Inlet Invert - 340.40 N.G.V.D.

(iv) Outlet Invert - 339.55 N.G.V.D.

2. Sluice gate

(a) Use - Primarily used to control inflow from Ditch 1 to increase water level in Pond 1 in conjunction with operation of radial arm gate on Ditch 1. However during period of high water levels in Pond 1, the radial arm gate on Ditch 1 can be opened and outflow can occur out of Pond 1 through the sluice gate to Ditch 1.

(b) Type - 2 - 72 inch x 60 inch Hardesty steel gates

(c) Opening (each) - 6 feet x 5 feet

(d) Inlet invert - 340.7 N.G.V.D.

(e) Low chord - 345.7 N.G.V.D.

j. Emergency Spillway.

(1) Use - Primarily used to allow inflow to upper end of Pond 1, however during period of high water levels within Pond 1 discharges could flow out of Pond 1 into Ditch 1.

(2) Type - Uncontrolled irregular earthen section along top of levee structure. (Plate 4)

(3) Crest Elevation - 346.1 N.G.V.D.

(4) Width of weir - 350 feet (avg. at 347.0 N.G.V.D.)

(5) Side Slopes - Left Abutment - 1V on 30H
Right Abutment - 1V on 67H

k. Regulating Outlet. The three culverts and sluice gates can be operated to control the water surface elevation. The normal recreation pool level is 345.5 N.G.V.D.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The engineering design data consists of a set of plans and drawings for the entire Duck Creek Wildlife Refuge. The portion of the plans pertinent to this report are referred to in the plans as Pool 1. The dam was designed by the Missouri Department of Conservation in 1951 and 1952. The plans of interest consist of typical cross-section profiles at each culvert and the concrete sluice gate. Also surface areas and storages values for Pond 1 can be found in this set of plans and drawings.

2.2 CONSTRUCTION

The dam was built in 1953 by the Missouri Department of Conservation. Construction equipment reportedly used were tractors, dozers, graders, and scrapers. The type of compaction equipment used is unknown. The borrow material came from the areas adjacent to the levee system. The borrow material consisted of native sands, silts, and clays. Riprap has been placed abundantly on the lake side of the levee to impede erosion and wave wash.

The embankment was designed with a 22 foot crown width and the field survey shows that the crown width varies from a minimum of 14 feet at the northern end to a maximum of 40 feet along the eastern edge with a typical crown width of 22 feet. The design levee crown elevation for Pond 1 was 349.0 N.G.V.D.. However the field survey indicated that the levee crown elevations varied from a minimum of 346.1 N.G.V.D. at a low point in the northwestern corner to a maximum of 349.5 N.G.V.D. along the southern and western boundary. However, the levee crown elevation was greater than 348.0 N.G.V.D except for an area of limited extent along the northern and northeastern boundary (see Plate 4). The plans indicate that the slopes were designed at 1V on 3H for the lakeside embankment and primarily 1V on 2H for the landside embankment. The field survey indicates an average slope of 1V on 3.45H for lakeside and 1V on 2.9H for landside (see Plate 5).

The plans show the location of 3 culverts and a sluice gate for controlling the lake level. The culvert at Section "B" (Sta 18+04) was designed as a 36-inch CMP - 72 feet long with an inlet invert elevation of 339.0 N.G.V.D. However, the field survey indicates a 36-inch CMP - 61 feet long with an invert elevation of 339.2 N.G.V.D. The discharge is controlled by a slide gate water control structure whose top elevation is 347.1 N.G.V.D. The design elevation for the top of the control structure was 347.0 N.G.V.D. The purpose of this culvert is to fill Pond 3 when needed. The culvert at Section "E" (Sta 65+43) was not surveyed by the inspection team. The design called for 90 feet of 42-inch CMP pipe with an invert elevation of 336.0 N.G.V.D. Information later obtained indicated that a 42-inch CMP with an invert elevation of 336.0 N.G.V.D. was installed. The primary purpose of the culvert is to control the lake level by discharge into Ditch 1 which runs parallel to the western boundary of Pond 1. The culvert at Section "Q" (Sta 350+77) was designed as a 36-inch CMP - 214 feet long with an additional 3 feet for the slide gate water control structure. The design invert elevation was 341.5 N.G.V.D. and the top of the slide gate water control structure was 347.0 N.G.V.D. The field survey indicates that a 36-inch CMP installed with a length of 218 feet which includes the width of the water control structure. The invert elevation was determined to be 340.4 N.G.V.D. and the top of the slide gate water control structure was 347.2 N.G.V.D. The primary purpose of this culvert is to fill Pond 2.

A sluice gate is located at Section "H" (Sta 139+63) and is primarily used to control inflow to Pond 1 from Ditch 1. The design invert elevation was 341.0 N.G.V.D. The field survey indicated an invert elevation of 340.7 N.G.V.D. The total width of the sluice gate opening was measured to be 14.6 feet as indicated by a design of 14 feet 7 inches or 14.6 feet. The effective opening of each gate is 6 feet wide by 5 feet deep. The water level is controlled by two Hardesty steel gates (72" x 60"). The top of roadway across the intake structure was at an elevation of 349.73 N.G.V.D. while the design called for an elevation of 350.0 N.G.V.D.

2.3 OPERATION

Normal rainfall, evaporation and the water level control structures all combine to maintain a relatively stable water surface. A drainage area of 1960 acres is entirely enclosed within the levee. The normal recreation pool is at 345.5 N.G.V.D. Inflows can be obtained from Ditch 1 by closing a radial arm control structure on Ditch 1 and allowing the flow in Ditch 1 to be diverted through the sluice gate structure at Section "H" into the lake. The culverts at Sections "B" and "Q" are used primarily to fill Ponds 3 and 2, respectively, during the duck season. The filling of Pond 2 begins about mid-September and continues from 1 to 4 weeks. The filling of Pond 3 begins about the first of October. The normal winter pool elevation for Pond 1 is 342.5 N.G.V.D. If any water is left in Pond 1 after the filling of Ponds 2 and 3, the excess storage is diverted into an area immediately west of Pond 1 until the water surface in Pond 1 reaches 342.5 N.G.V.D. Under no circumstances is the water level in Pond 1 dropped below 342.5 N.G.V.D. The culvert at Section "E" is primarily used to control the water level within the lake. However, during periods of excessive rainfall, all gates can be opened to regulate the lake level. It was reported that the lake level could be dropped 1/10 feet per day. However, it was not indicated under what combination of gate and culvert openings this applied. The levee was reported to have never been overtopped.

2.4 EVALUATION

a. Availability. The set of plans and drawings are available from Missouri Department of Conservation, P. O. Box 180, Jefferson City, MO 65102. Operational data was obtained from several discussions with Refuge personnel at Duck Creek State Wildlife Refuge.

b. Adequacy. The plans and drawings were adequate in that they provided sufficient detail to determine that Pond 1 was built according to specifications. The plans covered in detail the size, location, and bill of materials of all hydraulic structures. The field and visual inspection reaffirmed that the plans and drawings were followed during the construction of Pond 1. The only hydrologic or hydraulic data available was the surface areas and storage volumes within Pond 1, which were adequate. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The field and visual inspection support the validity of the engineering data as presented in the set of plans and drawings. Some minor variations exist as denoted in Para 2.2 but are insignificant and are within field measurement errors.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. Visual inspection of Duck Creek State Wildlife Refuge Pond 1 was performed on 22 May 1979. Personnel making the inspection were employees of the Memphis District, Corps of Engineers, and included a geologist, hydraulic engineer, and soils engineer. An initial site briefing conference was conducted by personnel from the Duck Creek State Wildlife Refuge. Specific observations are discussed below.

b. Project Geology. The Duck Creek Dam is a unique structure as it consists of a U-shaped levee-type fill which was erected on an almost flat plain with a slight dip to the south. The dam was constructed by using local borrow and placing the material into an embankment surrounding three sides of the lake which formed inside the structure. The surface material underlying the dam and the lake area was used for the embankment and consists of sands, silts, and clays. The surface material is underlain by sand which in turn is underlain by non-marine sand and sandy clay. The dam is located in Seismic Zone 3.

c. Dam. The plan layout of Duck Creek Wildlife Refuge - Pond 1 is shown on Plate 3. Typical sections for all portions of the levee are shown on Plate 5. The embankment was designed with a 22 foot crown width and the field survey shows that the crown width varies from a minimum of 14 feet at the northern end to a maximum of 40 feet along the eastern edge with a typical crown width of 22 feet (see Photos 1,2,4,6, and 7). The design crown elevation for Pond 1 was 349.0 N.G.V.D.. However, the field survey indicated that the crown elevations varied from a minimum of 346.1 N.G.V.D. at a low point in the northwestern corner to a maximum of 349.5 N.G.V.D. along the southern and western boundary. However, the levee crown elevation was greater than 348.0 N.G.V.D. except for an area of limited extent along the northern and northeastern boundary (see Plate 4). The plans indicate that the lakeside embankment slopes were designed at 1V on 3H and the landside embankment slopes were primarily 1V on 2H. The field survey indicates an average slope of 1V on 3.45H for lakeside and 1V on 2.9H for landside (see Plate 5).

The maintenance of the levee crown and slopes was satisfactory. In many areas trees and small brush covered the landside slope. Only the southern boundary was free from significant brush and tree growth. All evidence of wash has been repaired with riprap. Riprap had also been placed to control animal burrows on the lakeside slope (see Photos 3, 4, and 5). The riprap protection was approximately 2 feet thick all around the lake except on the northern edge. No significant sloughing, caving or seepage was noticed. The normal pool elevation is 345.5 N.G.V.D.; however, the day of the inspection it was at an elevation of 345.6 N.G.V.D. The eastern and western boundaries were bordered by two ditches to carry the surface drainage from the areas north and east of the reservoir (see Photo 8). Also Ditch 1 on the western boundary serves as the influent to Pond 1 during filling periods as discussed in Section 4.

d. Appurtenant Structures. Three culverts, a sluice gate, and an emergency spillway provide the means of inflow and outflow for the pond. All discharge structures were satisfactorily maintained and appeared to be in good working condition. Photos 9 and 10 show the gated - control structure and outlet respectively for the 36-inch CMP culvert located at Station 350+77. This culvert is used to fill Pond 2 prior to the duck season. Photos 11 and 12 show the gated -control structure and outlet respectively for the 36-inch CMP culvert located at Station 18+04. This culvert is used to fill Pond 3 prior to the duck season. Photos 13 and 14 show the gated - control structure and outlet respectively for the 42-inch CMP culvert located at Station 65+43. This culvert is the primary culvert used to control the water level surface if necessary. Photos 15 and 16 show the sluice gate structure located at station 134+63. Photos 17, 18, and 19 show the radial arm structure on Ditch 1 immediately west of the sluice gate.

e. Reservoir Areas. No wave wash, excessive erosion, or slides were observed along the shoreline of the reservoir. Riprap had been placed along all portions of the lakeslope of the reservoir (see Photos 3 and 5) except for the northern boundary.

f. Downstream Channel. The downstream channels were satisfactorily maintained and in relatively good condition (see Photo 8). Photos 20-24 shows property and dwellings in the community of Idewild downstream of the reservoir.

3.2 EVALUATION

None of the conditions observed are significant enough to indicate a need for immediate action or a serious potential of failure. The maintenance of the levee and discharge structures appears to be adequate. The abundant growth of trees and brush on the landside and lakeside slopes are deficiencies which if left uncontrolled or uncorrected could lead to the development of potential problems.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Normal rainfall, evaporation and the water level control structures all combine to maintain a relatively stable water surface. A drainage area of 1960 acres is entirely enclosed within the levee. The normal recreation pool is at 345.5 N.G.V.D. Inflows can be obtained from Ditch 1 by closing a radial arm control structure on Ditch 1 and allowing the flow in Ditch 1 to be diverted through the sluice gate structure at Section "H" into the lake. The culverts at Sections "B" and "Q" are used primarily to fill Ponds 3 and 2, respectively during the duck season. The filling of Pond 2 begins about mid-September and continues from 1 to 4 weeks. The filling of Pond 3 begins about the first of October. The normal winter pool elevation for Pond 1 in 342.5 N.G.V.D. If any water is left in Pond 1 after the filling of Ponds 2 and 3, the excess storage is diverted into a pool area immediately west of Pond 1 until the water surface in Pond 1 reaches 342.5 N.G.V.D. Under no circumstances is the water level in Pond 1 dropped below 342.5 N.G.V.D. The culvert at Section "E" is primarily used to control the water level within the lake. However during periods of excessive rainfall all gates can be opened to regulate the lake level. It was reported that the lake level could be dropped 1/10 feet per day. However it was not indicated under what combination of gate and culvert openings this applied. The lake level and levee system is inspected at least twice a day normally and 24 hour monitoring can be implemented if necessary.

4.2 MAINTENANCE OF DAM

It is apparent that maintenance is a high priority item at Duck Creek Wildlife Refuge. The top of the levee is well graveled and graded. Riprap has been placed along most of the shoreline and extra riprap has been placed in some areas for extra wavewash and erosion protection.

4.3 MAINTENANCE OF OPERATING FACILITIES

All hydraulic structures are well-maintained and appear to be in satisfactory operating conditions.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

The operational and maintenance schedules seem to be adequate for their intended purposes.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No hydraulic nor hydrologic design data exists. However surface area and storage values can be found in the set of plans and drawings available from the Missouri Depar ment of Conservation.

b. Experience Data. The drainage area is totally enclosed within the boundary of Pond 1 and is approximately 1960 acres. The top of dam and spillway layouts are from the survey made during the inspection.

c. Visual Observations. The plans show the location of 3 culverts and a sluice gate for controlling the lake level. The culvert at Section "B" (Sta 18+04) was designed as a 36-inch CMP - 72 feet long with an inlet invert elevation of 339.0 N.G.V.D. However, the field survey indicates a 36-inch CMP - 61 feet long with an invert elevation of 339.2 N.G.V.D. The discharge is controlled by a slide gate water control structure whose top elevation is 347.1 N.G.V.D. The design elevation for the top of the control structure was 347.0 N.G.V.D. The purpose of this culvert is to fill Pond 3 when needed. The culvert at Section "E" (Sta 65+43) was not surveyed by the inspection team. The design called for 90 feet of 42-inch CMP pipe with an invert elevation of 336.0 N.G.V.D. as was later verified to be true. The primary purpose of the culvert is to control the lake level by discharge into Ditch 1 which runs parallel to the western boundary of Pond 1. The culvert at Section "Q" (Sta 350+77) was designed as a 36-inch CMP - 214 feet long with an additional 3 feet for the slide gate water control structure. The design invert elevation was 341.5 N.G.V.D. and the top of the slide gate water control structure was 347.0 N.G.V.D. The field survey indicates that a 36-inch CMP was installed with a length of 218 feet which includes the width of the water control structure. The invert elevation was determined to be 340.4 N.G.V.D. and the top of the slide gate water control structure was 347.2 N.G.V.D. The primary purpose of this culvert is to fill Pond 2.

A sluice gate is located at Section "H" (Sta 134+63) and is primarily used to control inflow to Pond 1 from Ditch 1. The design invert elevation was 341.0 N.G.V.D. The field survey indicated an invert elevation of 340.7 N.G.V.D. The total width of the sluice gate opening was measured to be 14.6 feet as indicated by a design of 14 feet 7 inches or 14.6 feet. The effective opening of each gate is 6 feet wide by 5 feet deep. The water level is controlled by two Hardesty steel gates (72" x 60"). The top of roadway across the intake structure was at an elevation of 349.73 N.G.V.D. while the design called for an elevation of 350.0 N.G.V.D.

An emergency spillway exists from Sta 184+80 to Sta 190+54 with a crest elevation of 346.1 N.G.V.D. Also portions of the northern boundary and portions of the eastern boundary of the top of the levee are at elevations below 348.0 N.G.V.D., particularly from Sta 225+00 to Sta 276+86.

d. Overtopping Potential. The discharge system is adequate to meet the criteria set forth in the guidelines for a dam classified as an intermediate size dam with a high downstream hazard potential. The spillway design flood for the above classification is the PMF (Probable Maximum Flood). The Probable Maximum

Flood is defined as the flood resulting from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.The PMF will cause an outflow of 9070 cfs at an elevation of 347.3 N.G.V.D. A portion of the levee from Sta 227+00 to Sta 270+00 will be overtopped. The one-half PMF will cause an outflow of 1250 cfs at an elevation of 346.5 N.G.V.D. A portion of the levee from Sta 230+00 to Sta 255+00 will be overtopped. However, no downstream hazard should result from this overtopping since the overtopped levee is only about 1.5 ft. as shown by levee section "L" on Plate 5. The PMF and one-half PMF will overtop the levee an average of about 1 ft. and less than 0.5 ft., respectively. During these floods, the water surface on the landside of the levee would more than likely be equal to that on the lakeside. The worst condition would be if the landside were dry, the storm occurred over the lake, and the northern levee was overtopped. But even for this situation, the 1.5- to 1-ft. high flood wave would not present a hazard to loss of life for the residences of Idlewild and Kinder, Missouri, which are about 3 to 4 miles downstream of the northern levee. The data utilized in the preparation of these estimates were various Federal reports, data from field inspection and survey, and output from COE program, HEC-1, Dam Safety Version. The assumptions utilized in developing the routing criteria are outlined in Appendix A.

SECTION 6 - STRUCTUF ^L STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of the dam and appurtenant structures are discussed and evaluated in SECTIONS 3 and 5.

b. Design and Construction Data. The design and construction data were limited to that information discussed in SECTION 2.

c. Operation Records. There have been no known operations which have affected the structural stability of the dam.

d. Post Construction Changes. No post construction changes exist.

e. Seismic Stability. This dam is located in Seismic Zone 3. Since this dam is located in Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the levee.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several items were noted during the visual inspection which should be corrected or controlled. A priority item was the lack of seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" and this is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. The abundance of trees and brush on the landside of the levee was noted except for the southern boundary which is virtually cleared of any trees and brush. No seepage was observed on the landside slope of the levee. The Probable Maximum Flood (the spillway design flood) and one-half of the Probable Maximum will overtop the northern portion of the levee. However, no downstream hazard potential should arise from this overtopping. Also, no warning system had been developed in the event of impending failure.

b. Adequacy of Information. The conclusions in this report were based on reported performance history, a set of plans and drawings furnished by the Missouri Department of Conservation, a field survey, and external visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The stability and seepage analyses should be given priority by the owner and accomplished without delay in order to determine if corrective measures are necessary. If the safety deficiencies listed in para 7.1a. are not corrected in a timely manner, they could lead to the development of potential problems.

d. Necessity for Phase II. Based on the results of the Phase I inspection, no Phase II inspection is recommended.

e. Seismic Stability. This dam is located in Seismic Zone 3. Since this dam is located in Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the levee.

7.2 REMEDIAL MEASURES

a. Alternatives. The height of the levee could be increased or additional drainage structures could be installed to pass the Probable Maximum Flood without overtopping any portion of the levee.

b. Perform seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspections of Dams." These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. O&M Maintenance and Procedures. The following O&M maintenance and procedures are recommended:

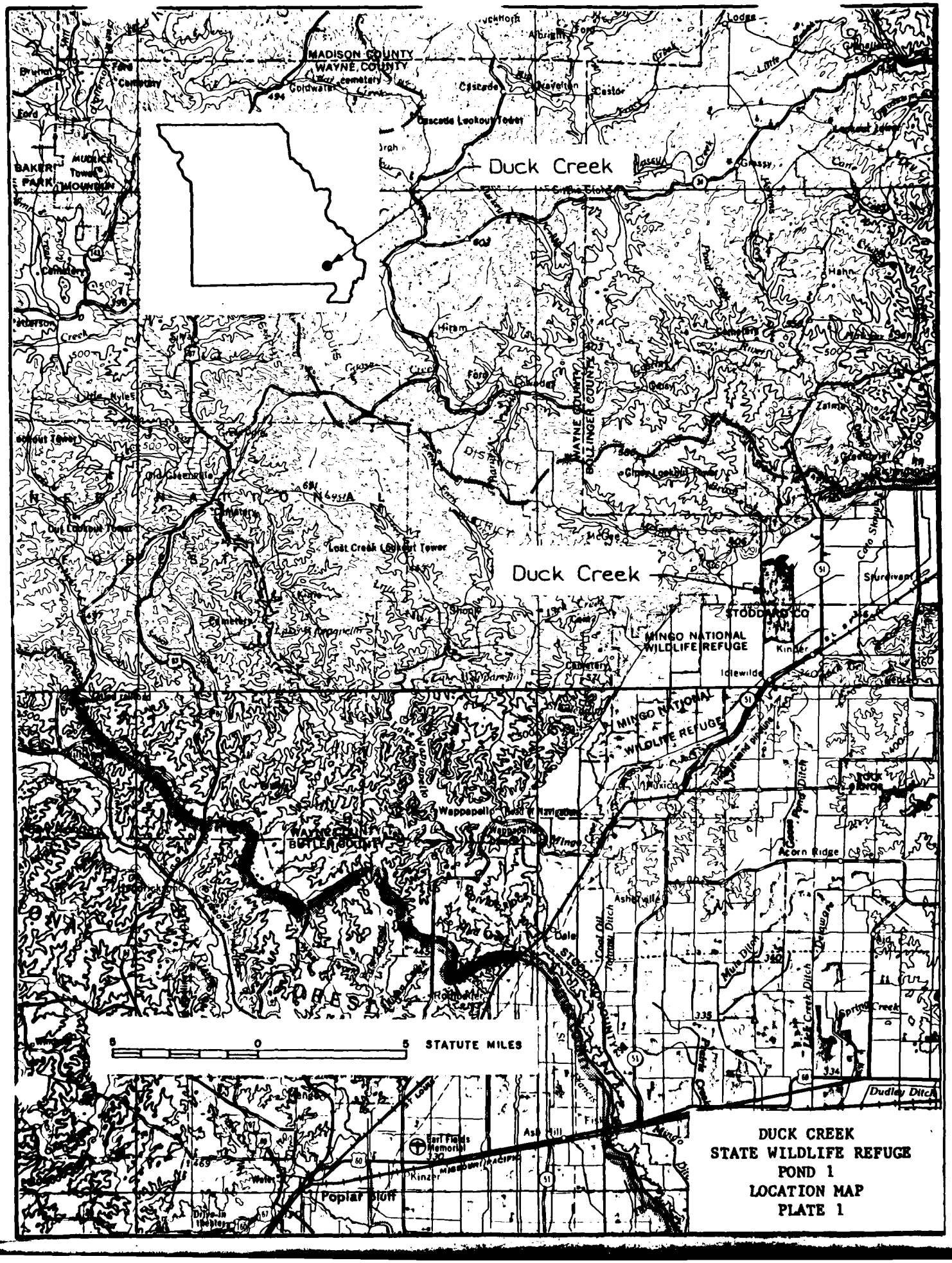
(1) Remove trees and brush on landside slope of levee from toe of levee to crown. Care should be taken during removal not to destroy the existing conditions of the landside slope.

(2) Damage resulting from burrowing animals should be repaired and burrowing animals exterminated.

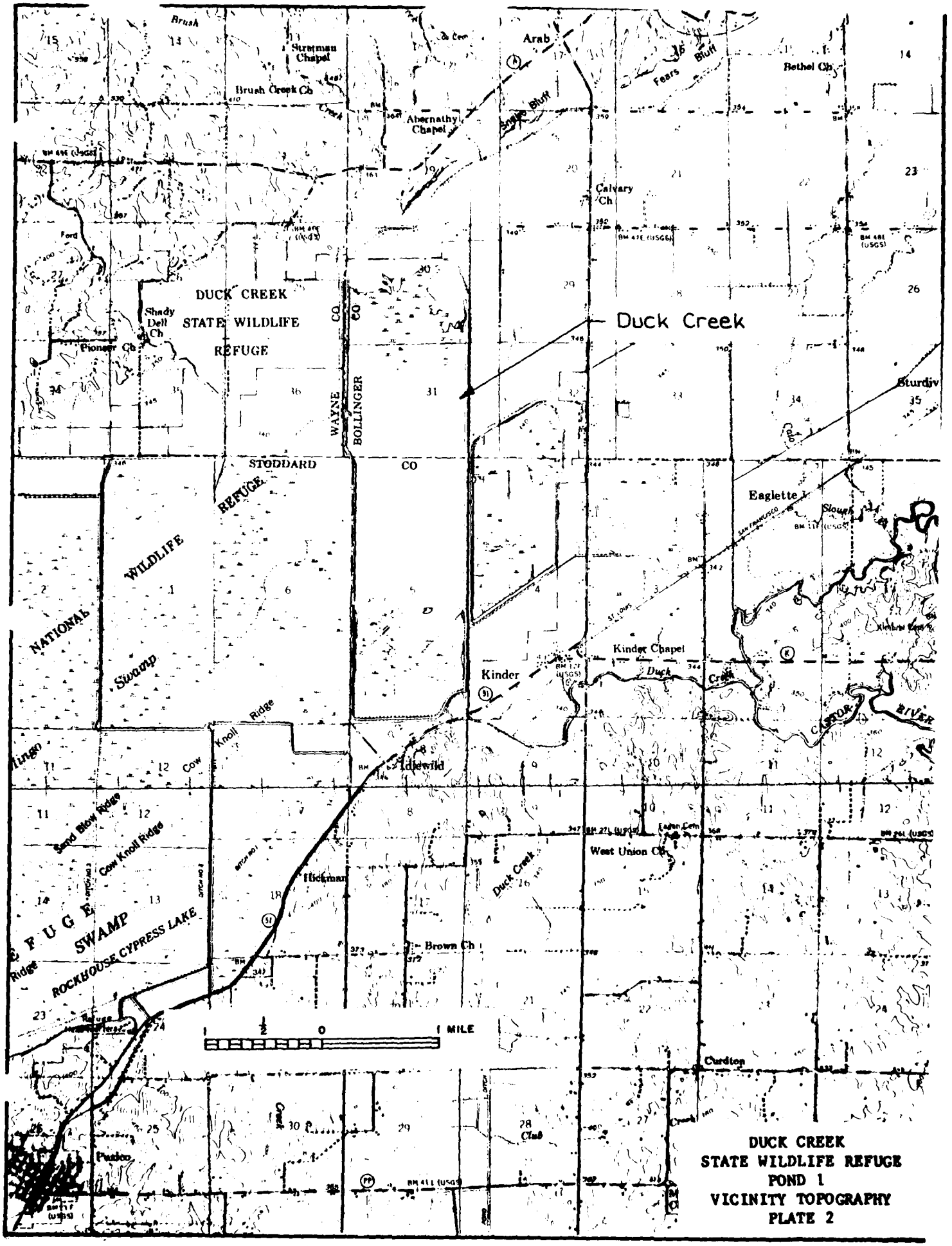
(3) The landside slope should be monitored periodically to insure that no seepage is occuring. If seepage or signs of material being piped from the embankment are observed, immediate action should be taken to rectify these conditions.

(4) A warning system to alert downstream residences should be developed and tested periodically to insure adequate and prompt alert notification.

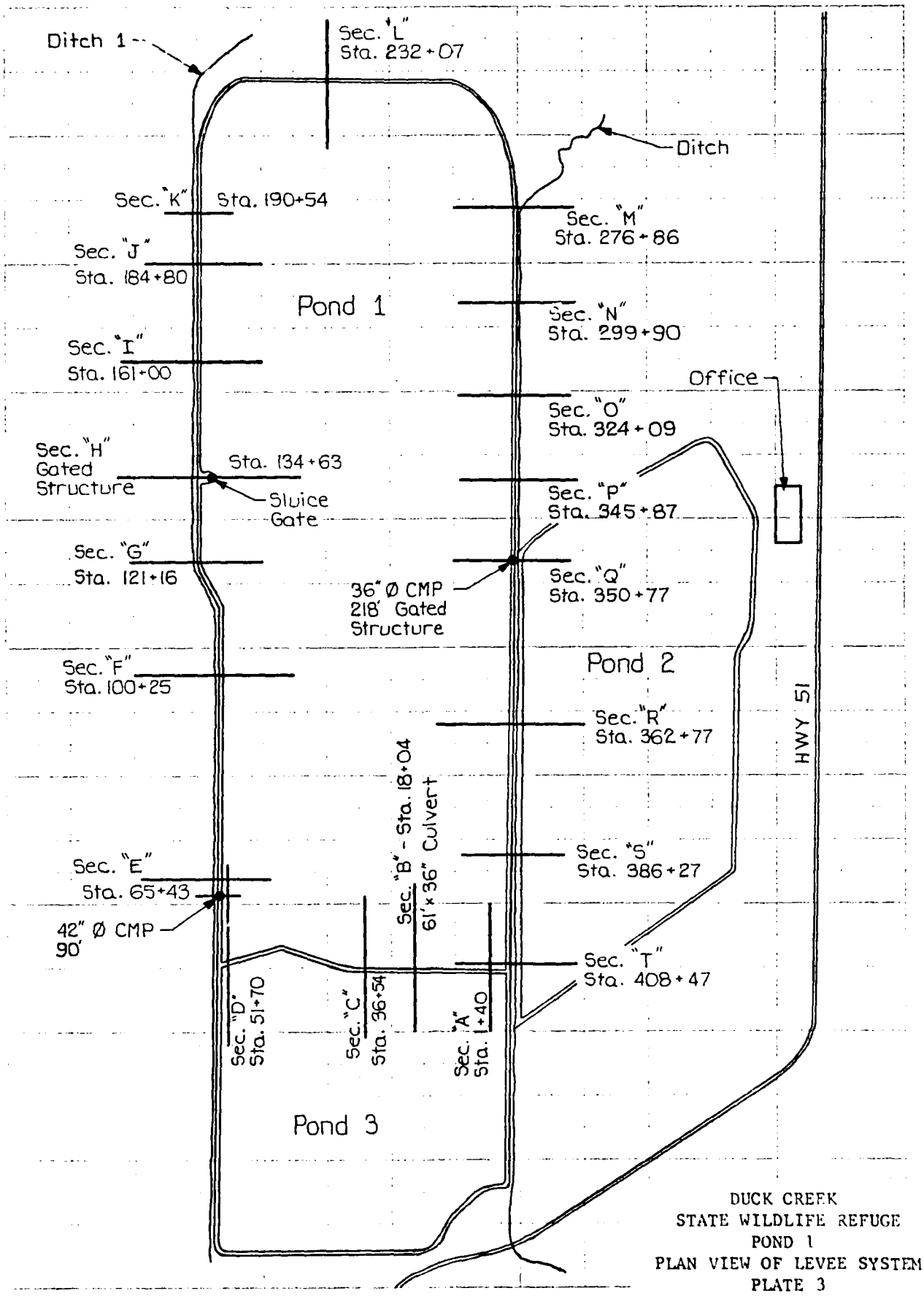
(5) A detailed inspection of the dam should be made at least every 5 years by an engineer experienced in design and construction of dams.



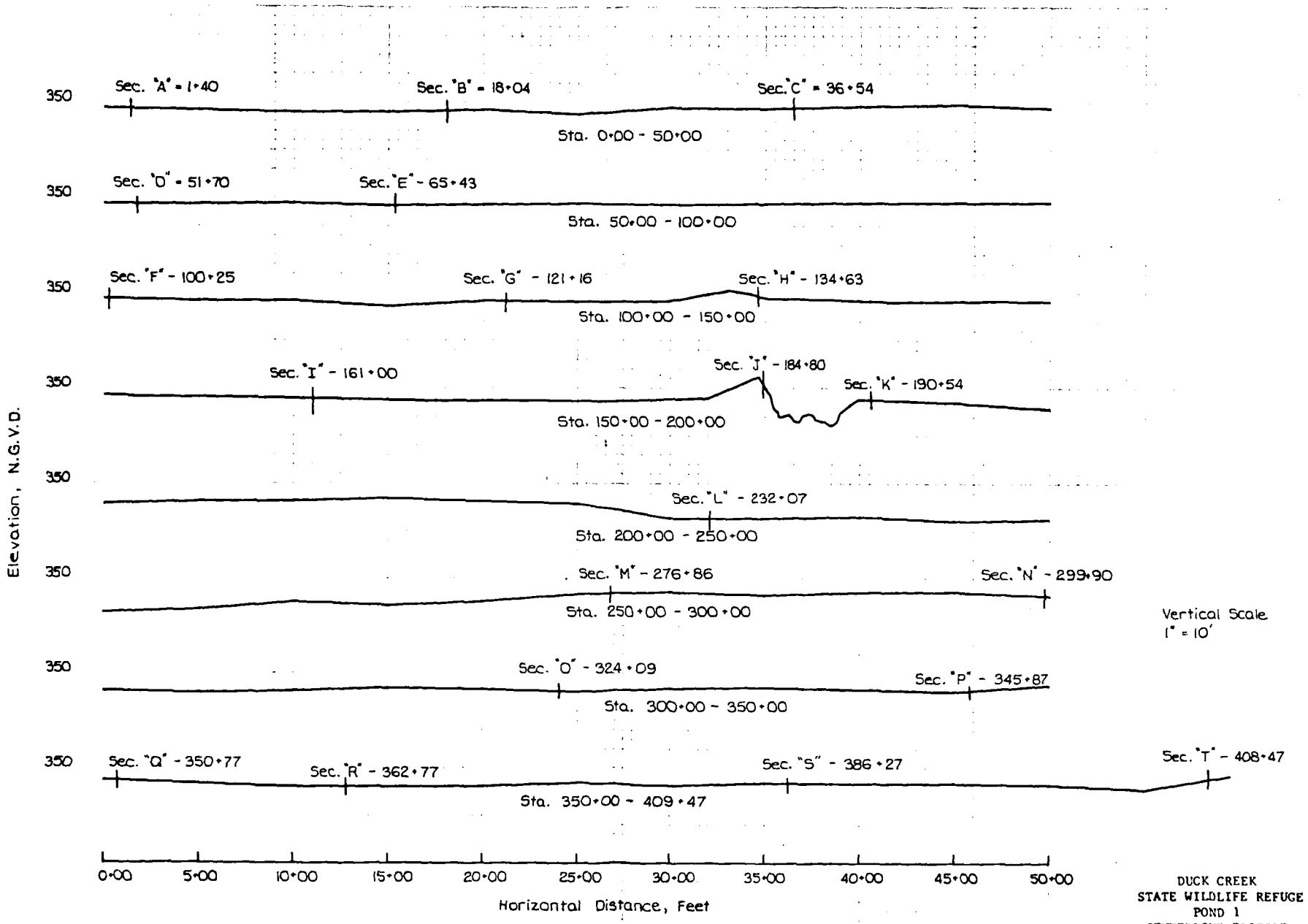
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
LOCATION MAP
PLATE 1



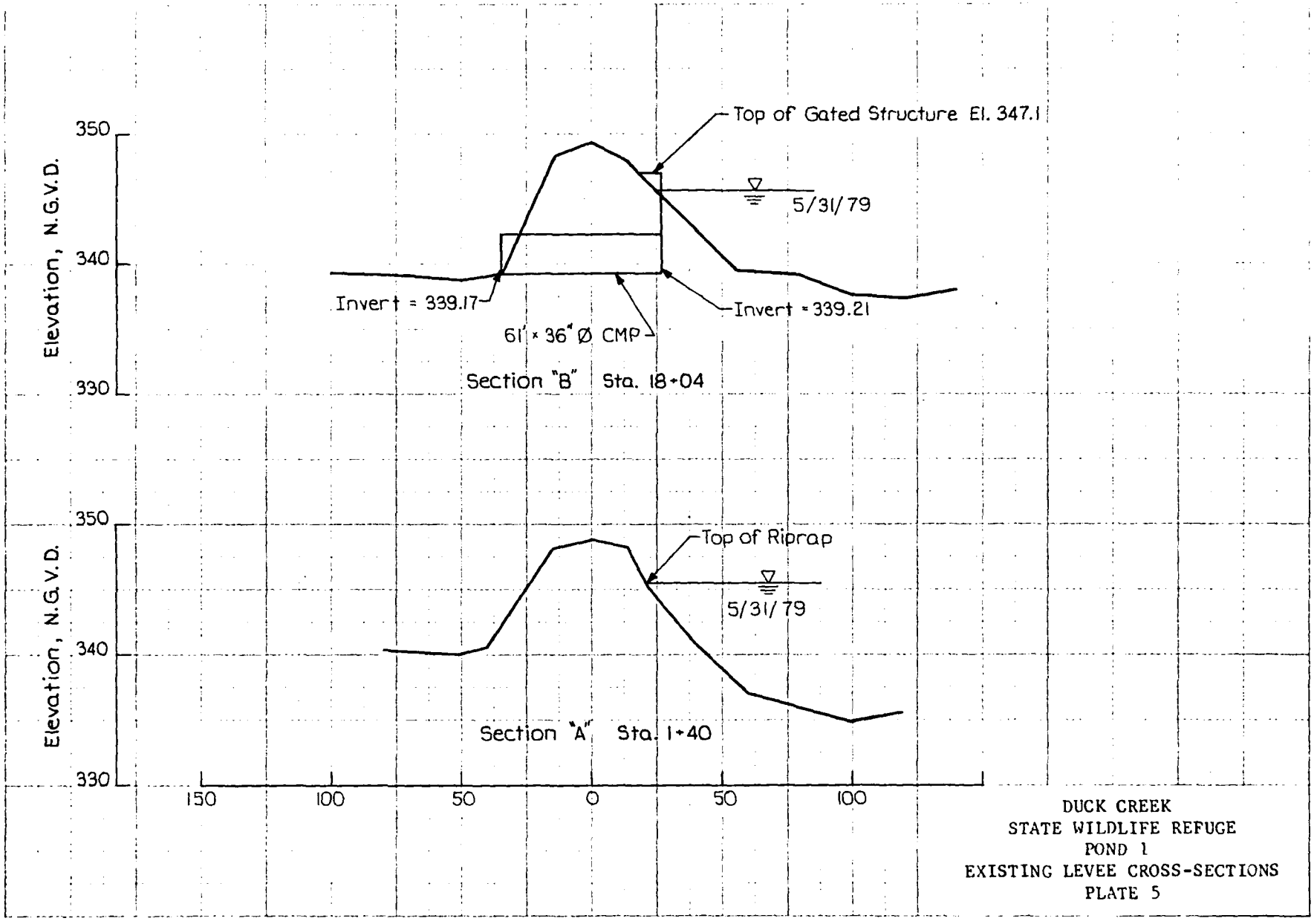
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
VICINITY TOPOGRAPHY
PLATE 2



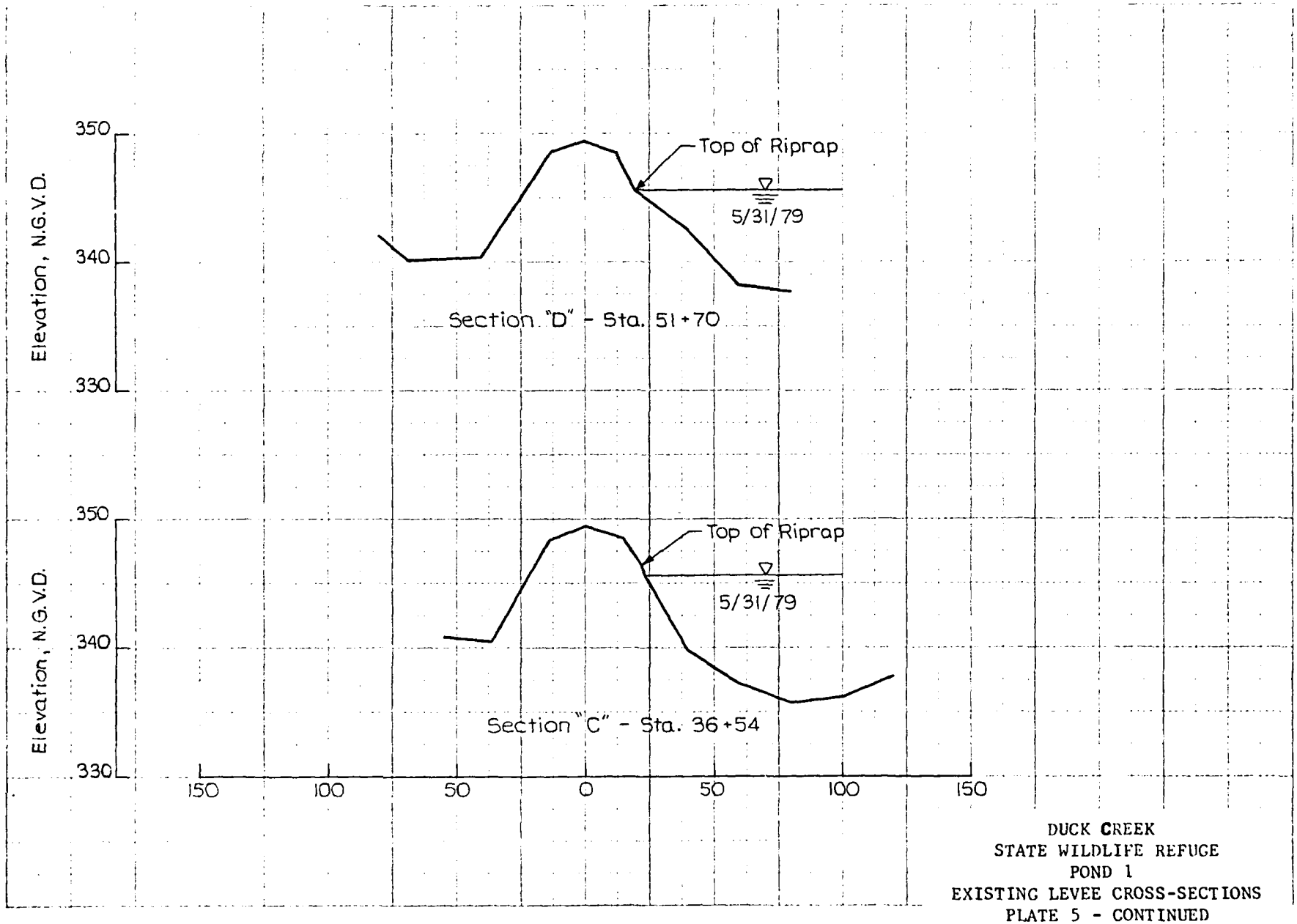
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
PLAN VIEW OF LEVEE SYSTEM
PLATE 3



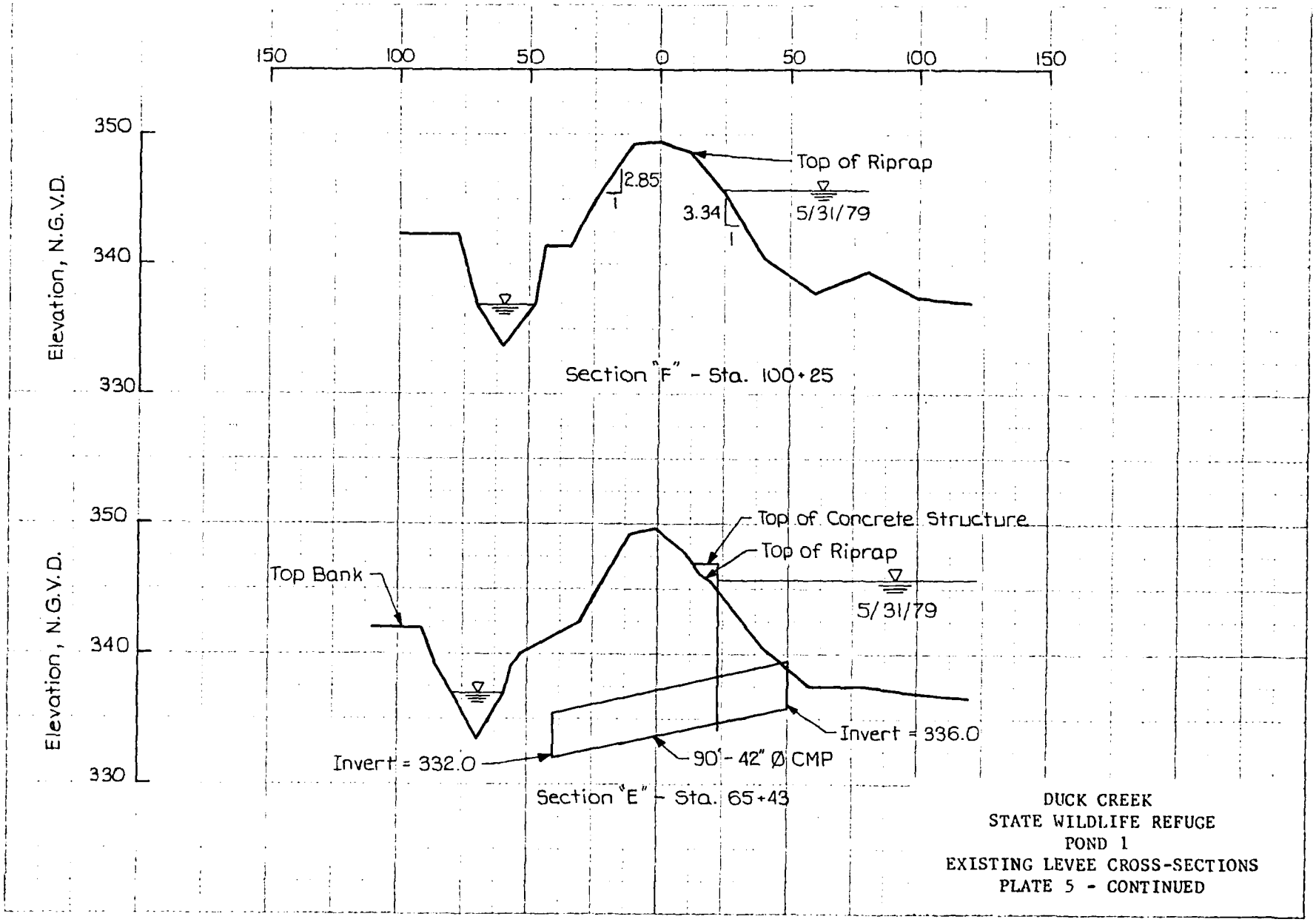
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
CENTERLINE PROFILE
PLATE 4



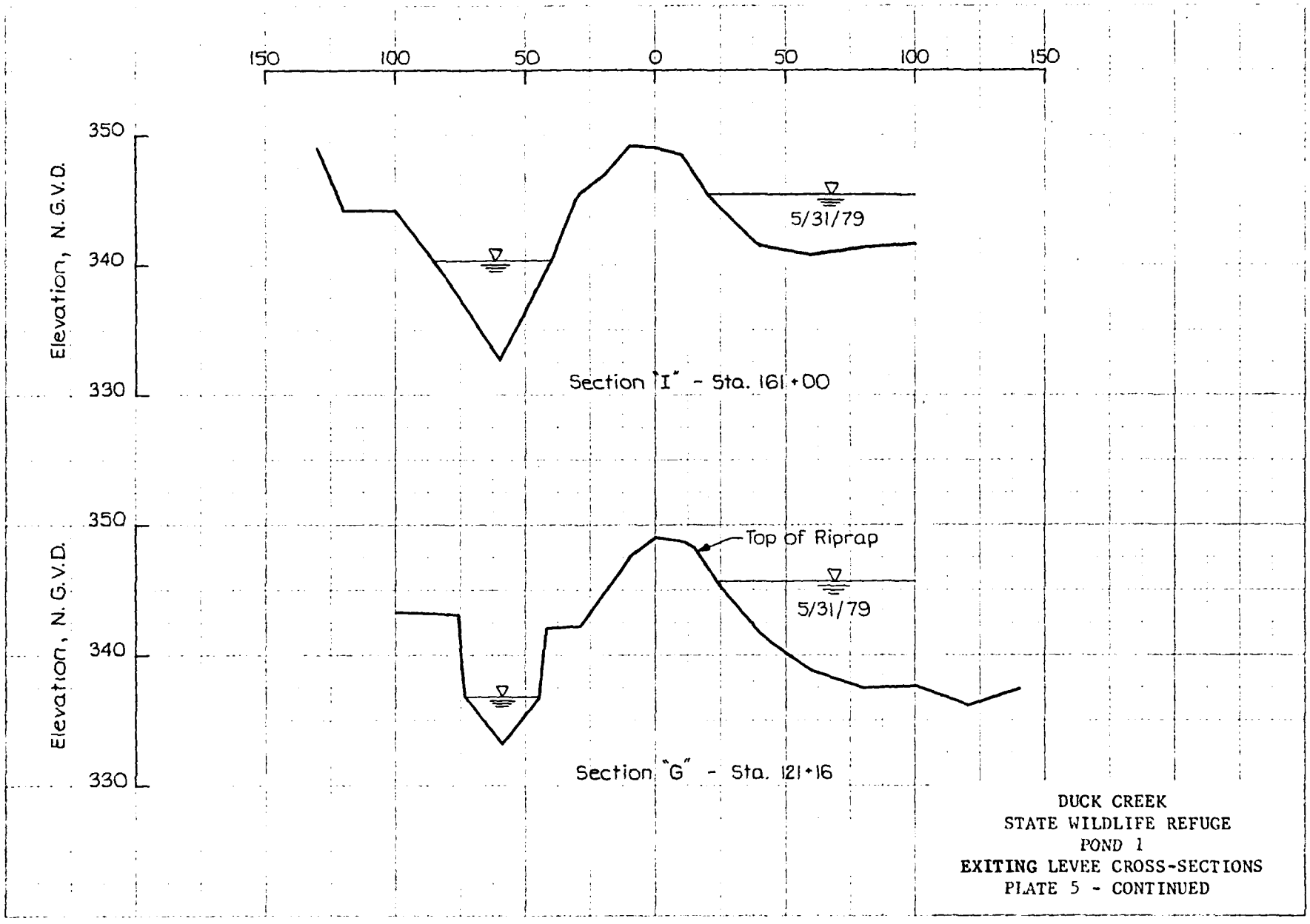
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXISTING LEVEE CROSS-SECTIONS
PLATE 5



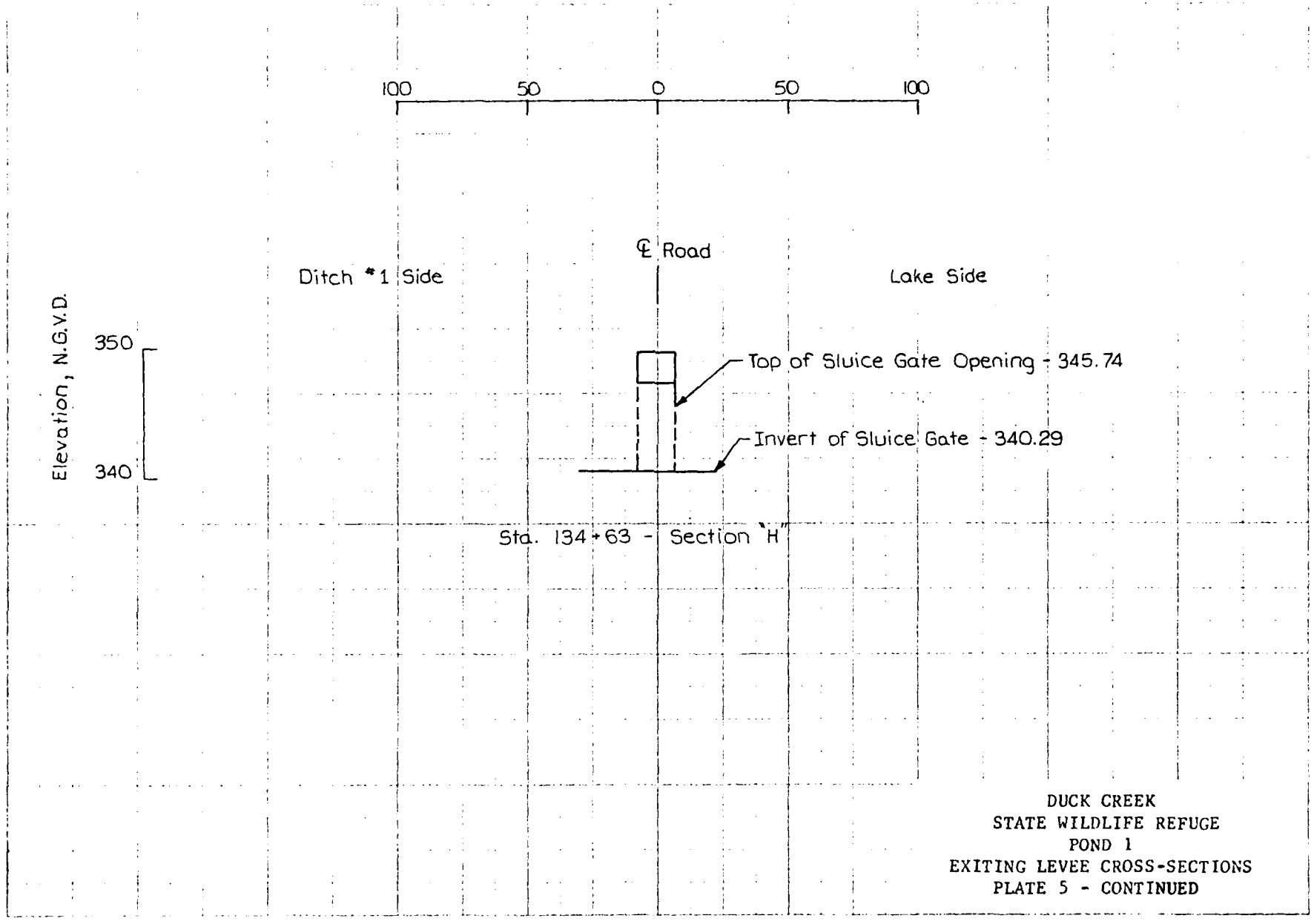
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXISTING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



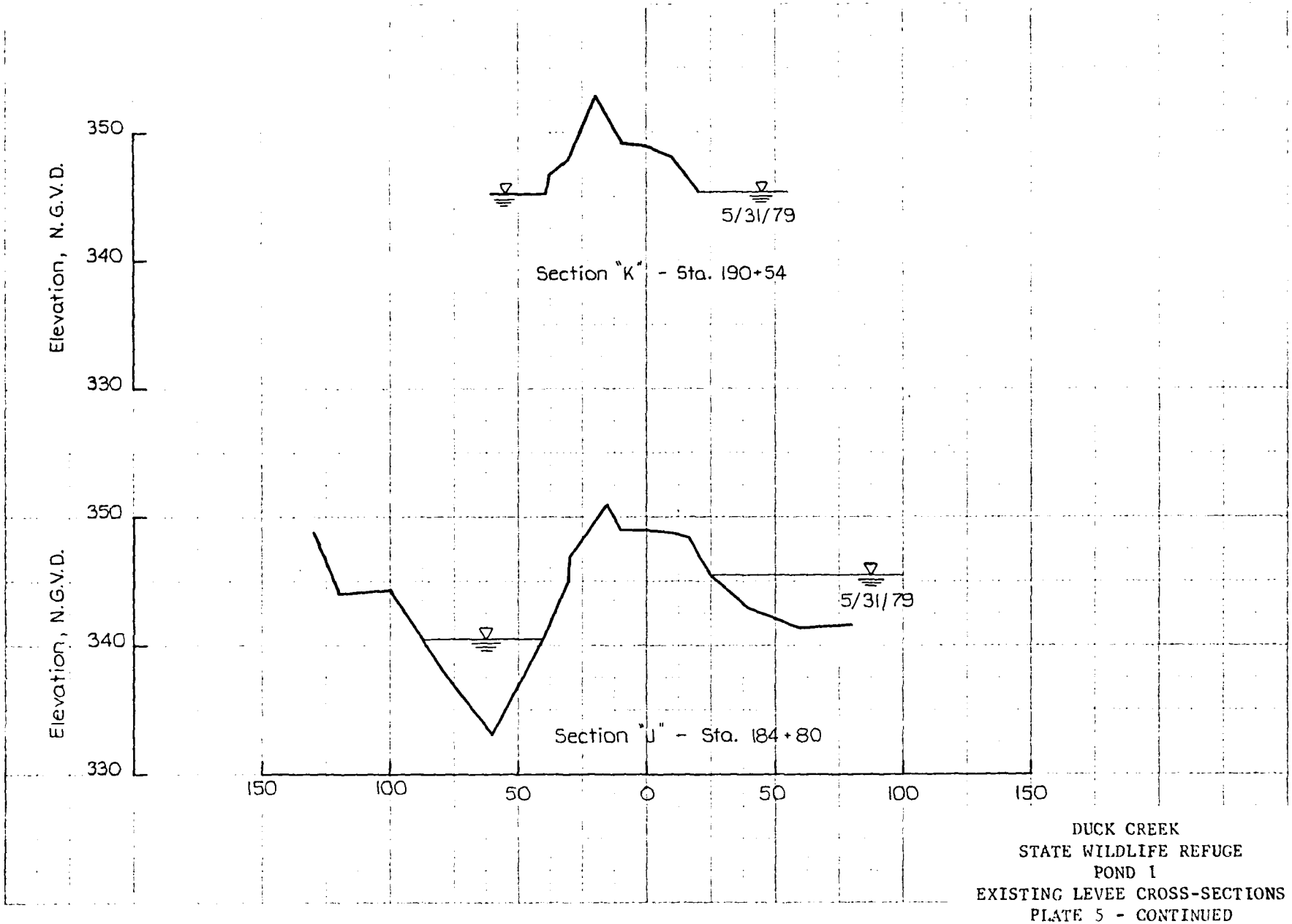
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXISTING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



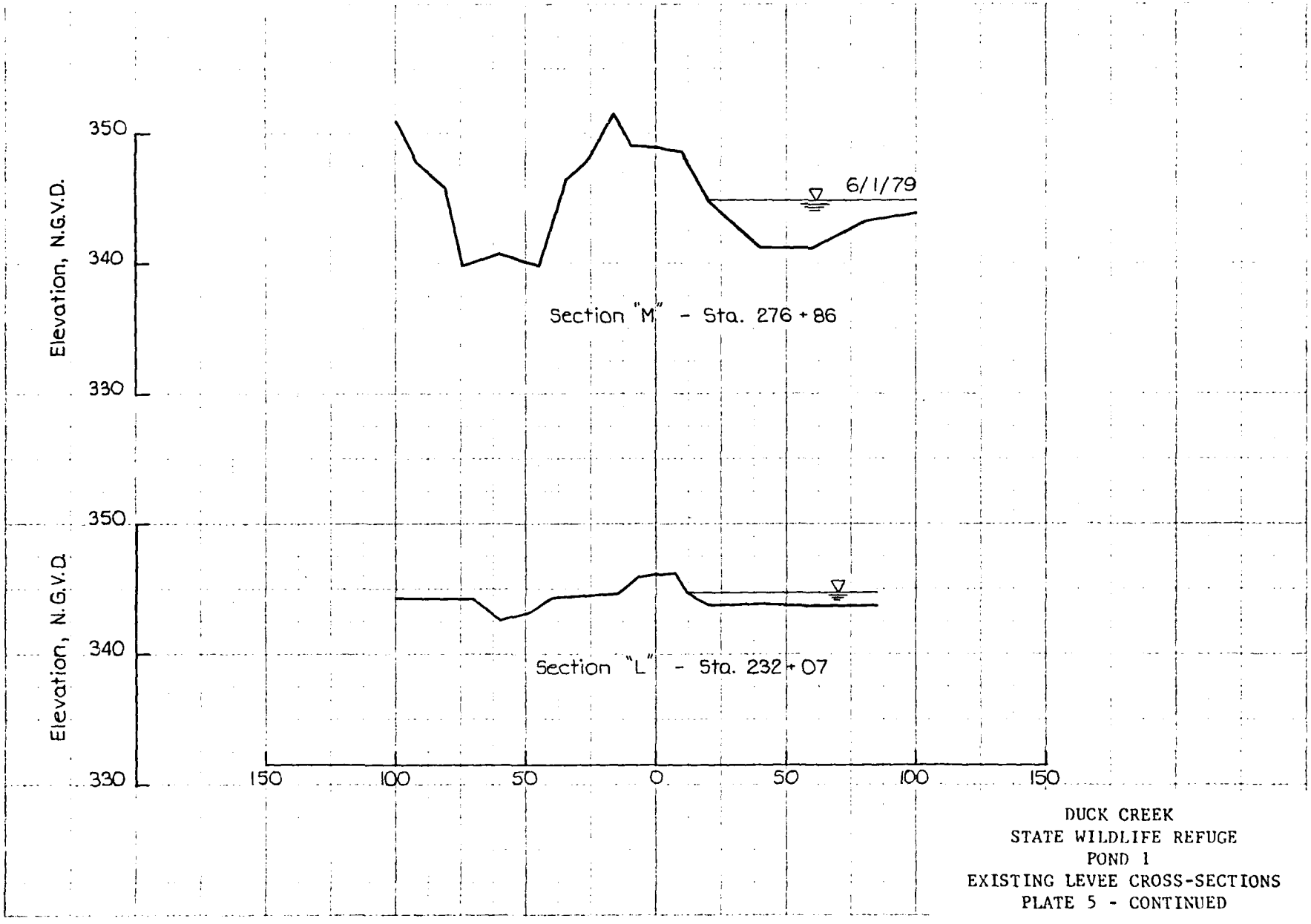
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXITING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



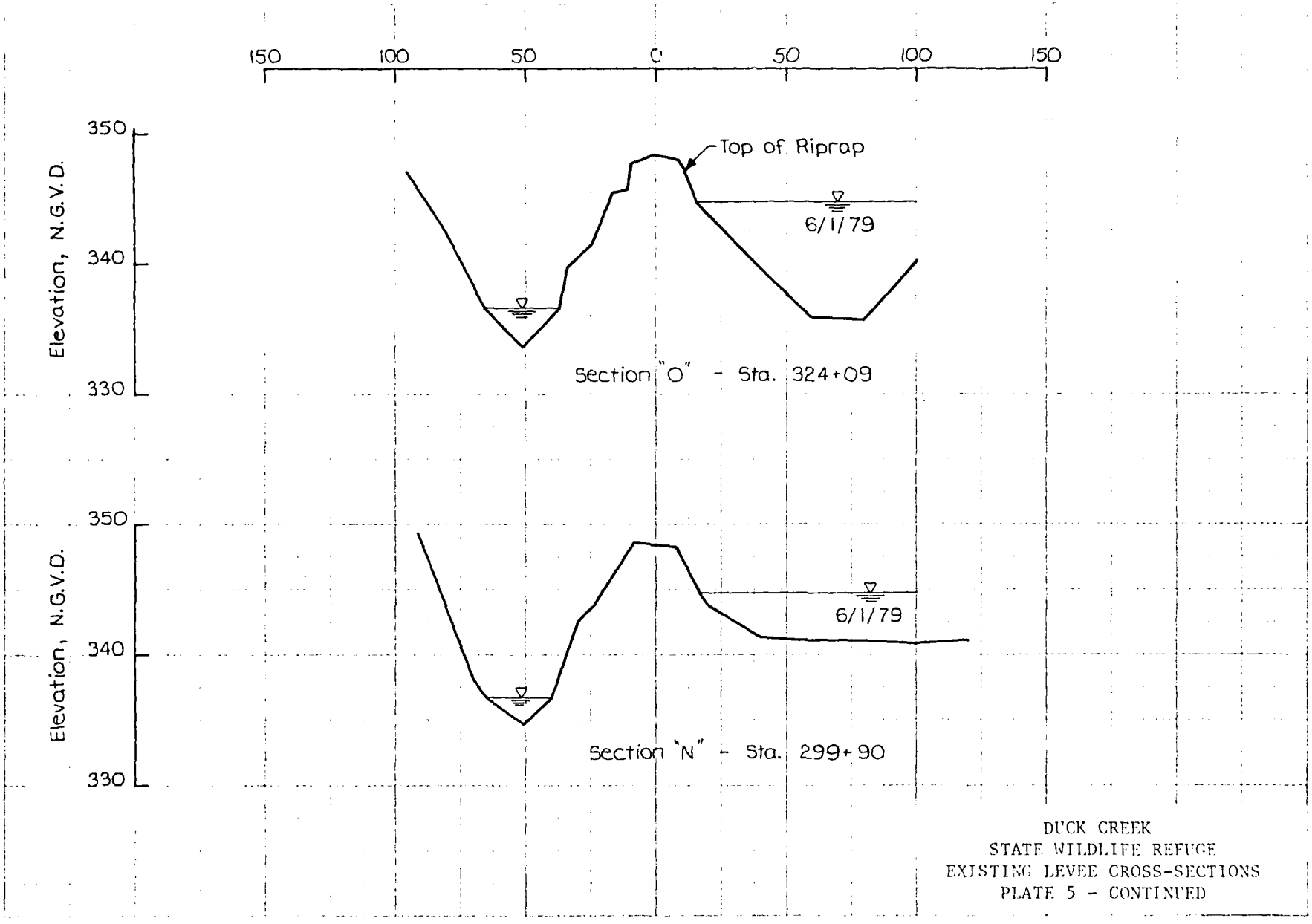
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXITING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



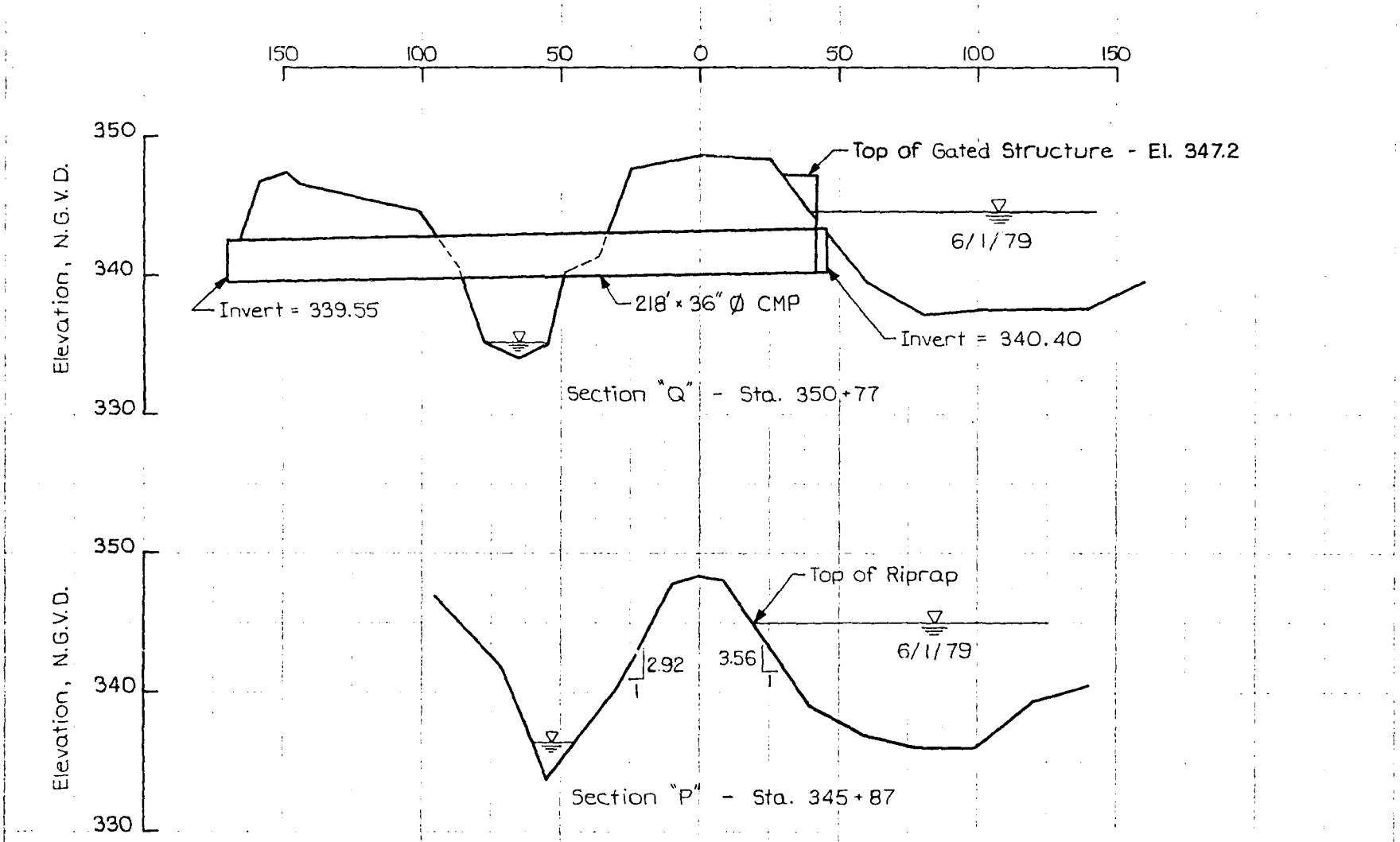
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXISTING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



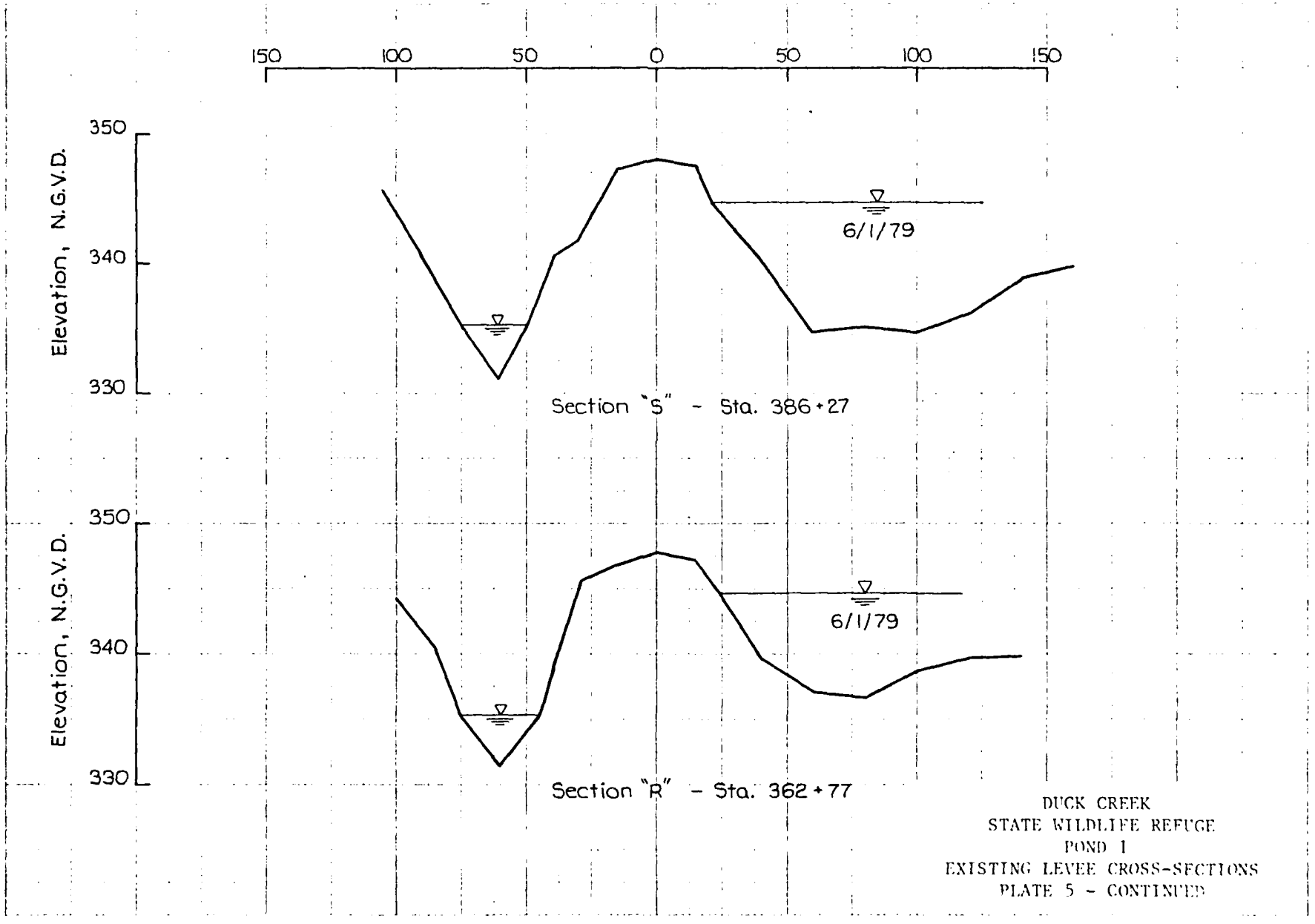
DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXISTING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



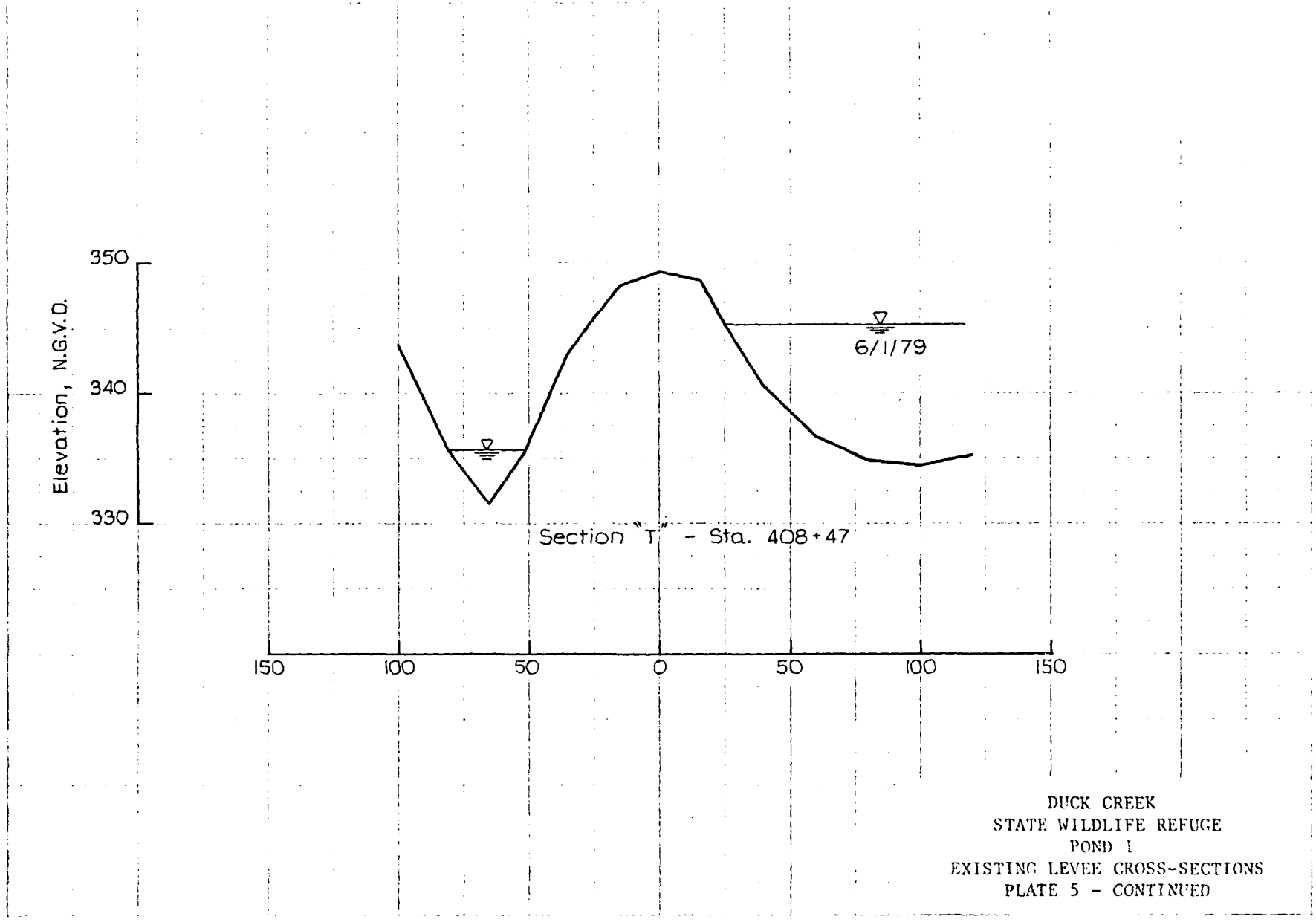
DUCK CREEK
STATE WILDLIFE REFUGE
EXISTING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXISTING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXISTING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED



DUCK CREEK
STATE WILDLIFE REFUGE
POND 1
EXISTING LEVEE CROSS-SECTIONS
PLATE 5 - CONTINUED

APPENDIX A

HYDROLOGY AND HYDRAULICS

1. Narrative. The methods and sources of data were primarily those suggested by the Hydraulics Branch, St. Louis District, Corps of Engineers. Specific references and methods will be discussed below. A field inspection and survey was made to determine the outlet structures and topgraphic characteristics of the dam. The entire drainage area for the Duck Creek State Wildlife Refuge - Pond 1 is enclosed within the levee system. Consequently all rainfall effectively goes into storage within the banks of the levee with no losses. Also the routing conditions were developed considering the normal operating procedures of daily inspection of the water surface elevation by personnel at the Refuge. It was hypothesized that the worst condition would occur when there was initially no discharge through the discharge structures for the first twenty-four hours. Consequently the storage within the reservoir will increase equal to the depth of the rainfall. At that time personnel at the Refuge would recognize an impending problem and coupled with a probable Weather Bureau forecast of a very intense rainstorm, the gates would be fully open. Also no past history of tail water conditions was known, consequently, the discharges through the culverts and sluice gate were rated considering unsubmerged tail water conditions.

a. Rainfall. The PMF was developed using Hydrometeorological Report No. 33. The "Hop Brook" reduction factor was not used to adjust the rainfall for this study. The distribution of rainfall was developed using the criteria as described by EM 1110-2-1411 (Standard Project Storm).

PMF Rainfall	27.2 in.
PMF Percentages	6 hr. - 102
	12 hr. - 120
	24 hr. - 130
	48 hr. - 140

b. Unit Hydrographs. The unit hydrograph was developed for a 10 min rainfall for a drainage area of 1960 acres considering that all the rainfall goes into storage.

$$Q = iA = i,in \times 11858 \text{ cfs}$$

Consequently the temporal distribution of inflow to the reservoir was developed by simply multiplying the rainfall in inches by 11858 to obtain the inflow in cfs.

c. Loss Rates. As previously discussed, it was assumed that the losses would be negligible or zero since all the rainfall would contribute directly to the surface of the reservoir.

d. Base Flow and Antecedent Flood Conditions. A base flow of 1 cfs was selected and the initial routing elevations were established as previously discussed in the narrative. The normal operating pool is at 345.5 N.G.V.D. The first 24 hours consists of 10% of the design rainfall as detailed below. Consequently the starting routing elevation was obtained by adding the increase in depth during the first 24 hours to 345.5 N.G.V.D.

Design Flood	Rainfall, inches	Depth, inches	Elevation, N.G.V.D.
PMF	27.2	2.72	345.73
½ PMF	13.6	1.36	345.61

e. Hydrograph Routing. The routing of the inflow through the Duck Creek State Wildlife Refuge - Pond 1 is a combination of the computed outflow rating curve for three culverts and a sluice gate. Routing over the dam and spillway was accomplished using the non-level routing option of HEC-1, Dam Safety Version. Single step routing using the "Modified Puls" method was used to actually route the flow through the embankment. The rating for the structure was developed considering several cases, namely critical inflow for low level discharges and pipe-full conditions for high level elevations. Listed below are the assumptions used to perform the calculations on the various culverts and sluice gate.

(1) Culverts:

(a) (i) Sta 18+04 - Section "B"

Diameter - 36 inches - CMP
length - 61 feet
n = .024

Losses: $h_{ent} = \frac{1}{2} V^2/2g$ (both for critical condition and pipe-full condition)

$h_{exit} = V^2/2g$ (pipe - full conditions)

h_f = friction loss (Manning's Equation)

(ii) Critical

$$\frac{Q^2}{g} = \frac{A^3}{B}$$

$$H = y + h_f + \frac{V^2}{2g} = y + 1.5\frac{V^2}{2g} = y + \frac{1.5Q^2}{2gA^2}$$

Invert Elevation = 339.21 N.G.V.D.
Critical inflow governs to water surface elevation of 343.0 N.G.V.D.

(iii) Pipe - Full conditions

$$Q = .577\ A_{36''}\sqrt{2g}\ (H - 340.67)^{\frac{1}{2}}$$

$$= 32.7\ 3\ (H - 340.67)^{\frac{1}{2}}$$

For water surface elevation, H, greater than 343.0 N.G.V.D.

(b) (i) Sta 65+43 - Section "E"
Diameter - 42 inches - CMP
Length - 90 feet
n = .024
Losses: same as (a)(i)

(ii) Critical Assumption - N/A

(iii) Pipe-full conditions

$$Q = .550\ A_{42"}\sqrt{2g}\ (H - 333.75)^{1/2}$$

$$= 42.46\ (H - 333.75)^{1/2}$$

(c) (i) Sta 350+77 - Section "Q"
Diameter - 36 inches - CMP
Length - 216 feet
n = .024
Losses - same as (a)(i)

(ii) Critical Assumption

same as (a)(ii)

Invert Elevation = 340.40 N.G.V.D.

Critical inflow governs to water surface elevation between 343.0 N.G.V.D. and 344.0 N.G.V.D.

(ii) Pipe- Full Conditions

$$Q = .383\ A_{36}\sqrt{2g}\ (H - 341.05)^{1/2}$$

$$= 21.72\ (H - 341.05)^{1/2}$$

For water surface elevations, H, greater than 343.0 N.G.V.D.

(2) Sluice Gate

(i) OPENINGS - 2
Dimensions 6 feet X 5.45 feet

(ii) Critical Assumptions

$$H = 3/2\ y_c$$

$$y_c = \sqrt[3]{q^2/g}$$

$$Q = qB \quad , B = 12 \text{ feet}$$

Invert Elevation = 340.29 N.G.V.D.

Critical inflow equations governs to a water surface elevation of 347.0 N.G.V.D.

(ii) Sluice Gate

$$Q = C_D W (2g H)^{\frac{1}{2}}$$

$W = 5.45$ feet

$$C_D = .608/ (1+ \frac{.608 \times W}{H})^{\frac{1}{2}}$$

H, height of head, invert elevation of 340.29 for any water surface elevation equal to or greater than 348.0 N.G.V.D.

The combined output rating curve can be found on the Y4 and Y5 cards of the computer input.

f. Storage. The storage values were calculated by HEC-1, Dam Safety Version using as input the surface areas of the reservoir and respective elevations as determined from the set of plans and drawings.

½ PMF

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*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 80
*************************************
A                              NON-FEDERAL DAM INSPECTION
A                                    DAM #40063
A                                    DUCK CREEK
B      144       0      10      -0      -0      -0      -0      -0      -0      -0
B1       5
J        1       1       1
J1      .5
K        0       1                                      1
I PROBABLE MAXIMUM PRECIPITATION-06 HR DURATION\NO OUTFLOW IN INITIAL 24 HRS'
W        1      -1  3.0625          3.0625      1.
P             27.2     102     120     130
T
O        1
1    11658
K        1       1       2
K        1       2                                      1
K1                    ROUTED FLOWS THROUGH DUCK CREEK LEVEE SYSTEM
Y                                    1       1
Y1       1                                      -345.01      -1
Y3     342     343     344     345     346     347     348     349     350     351
Y4     352
Y5233.53  305.70  497.63  632.96  776.22  930.12 1047.14 1123.04 1194.67 1262.65
Y51427.5
$A       0     160     511     662     896    1112    1209    1388    1477    1549
$A    1669    1686    1773    1842    1897    1929    1955    1960    1960
$E   339.0   339.5   340.0   340.5   341.0   341.5   342.0   342.5   343.0   343.5
$E   344.0   344.5   345.0   345.5   346.0   347.0   348.0   348.5   352.0
$S   348.3
$D   348.0
$L       0    1050    2050    2575    3450    4750    6200    9200   21150
$V   346.1   346.4   346.4   346.6   347.0   347.5   348.0   348.0   348.5
K       99
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½ PMF

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*******  ************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
*********************************

RUN DATE: 11 FEB 80
     TIME: 09.38.09

                         NON-FEDERAL DAM INSPECTION
                                DAM #40063
                                DUCK CREEK

                             JOB SPECIFICATION
      NQ    NHR   NMIN   IDAY    IHR   IMIN  METRC   IPLT   IPRT  NSTAN
     144      0     10     -0     -0     -0     -0     -0     -0     -0
                        JOPER    NWT  LROPT  TRACE
                            5     -0     -0     -0

                      MULTI-PLAN ANALYSES TO BE PERFORMED
                        NPLAN= 1 NRTIO= 1 LRTIO= 1
         RTIOS=    .50

**********         **********         **********         **********         **********

                          SUB-AREA RUNOFF COMPUTATION

     PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION-NO OUTFLOW IN INITIAL 24 HRS

        ISTAG   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE  IAUTO
            1       0      -0      -0      -0      -0       1      -0     -0

                               HYDROGRAPH DATA
      IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
          1     -1    3.06     -0.    3.06    1.00     -0.      -0      -0      -0

                                 PRECIP DATA
              SPFE     PMS      R6     R12     R24     R48     R72     R96
               -0.   27.20  102.00  120.00  130.00     -0.     -0.     -0.

                                  LOSS DATA
     LROPT  STRKR  DLTKR  RTIOL  ERAIN  STRKS  RTIOK  STRTL  CNSTL  ALSMX  RTIMP
        -0    -0.    -0.   1.00    -0.    -0.   1.00    -0.    -0.    -0.    -0.

                          GIVEN UNIT GRAPH, NUHGQ=    1
   11658.
              UNIT GRAPH TOTALS  11658. CFS OR 1.00 INCHES OVER THE AREA

                               RECESSION DATA
                  STRTQ=    1.00    QRCSN=    1.00    RTIOR= 2.00

                              END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q     MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q

  1.01    .10       1    .03    .03     0.      359.      1.01  12.10      73    .46    .46     0.     5483.
  1.01    .20       2    .03    .03     0.      359.      1.01  12.20      74    .46    .46     0.     5483.
  1.01    .30       3    .03    .03     0.      359.      1.01  12.30      75    .46    .46     0.     5483.
  1.01    .40       4    .03    .03     0.      359.      1.01  12.40      76    .46    .46     0.     5483.
```

½PMF

½PMF

SUMMARY OF D SAFETY ANALYSIS

½ PMF

PLAN 1 ..... ELEVATION STORAGE OUTFLOW

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	345.01	346.10	348.00
	7703.	8025.	12240.
	721.	744.	24536.

RATIO OF P-F	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	346.47	0.	9350.	1247.	0.	18.17	0.

½ PMF

PMF

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION   26 FEB 80
**********************************
A                                       NON-FEDERAL DAM INSPECTION
A                                                  DAM #40063
A                                                  DUCK CREEK
B     144       0      10      -0      -0      -0      -0      -0      -0      -0
B1      5
J       1       1       1
J1     1.
K       0       1                                       1
K1 PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION\NO OUTFLOW IN INITIAL 24 HRS'
M       1      -1  3.0625          3.0625      1.
P            27.2     102     120     130
T
W       1
X   11858
K       1       1       2
K       1       2                                       1
K1                  ROUTED FLOWS THROUGH DUCK CREEK LEVEE SYSTEM
Y                                       1       1
Y1      1                                              -345.73      -1
Y4    342     343     344     345     346     347     348     349     350     351
Y4    352
Y5243.83  365.70  497.83  632.56  778.22  934.12 1047.14 1123.04 1194.67 1262.65
Y51327.5
$A      0     180     511     662     896    1112    1269    1388    1477    1549
$A   1609    1666    1773    1842    1897    1929    1955    1960    1960
$E  339.0   339.5   340.0   340.5   341.0   341.5   342.0   342.5   343.0   343.5
$E  344.0   344.5   345.0   345.5   346.0   347.0   348.0   348.5   352.0
$$  346.1
$D  348.0
$L      0    1050    2050    2575    3450    4750    6200    9200   21150
$V  346.1   346.4   346.4   346.6   347.0   347.5   348.0   348.0   348.5
K      99
```

PMF

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 19 FEB 80
****

RUN DATE: 11 FEB 8
TIME: 14.50.17

PMF

NON-FEDERAL DAM INSPECTION
DAM #00603
DUCK CREEK

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRIC	IPLT	IPRT	NSTAN
100	0	10	=0	=0	=0	=0	=0	=0	=0

JOPER	NRT	LROPT	TRACE
5	=0	=0	=0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 1.00

PMF

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

PROBABLE MAXIMUM PRECIPITATION=24 HR DURATION AND OUTFLOW IN INITIAL 24 HRS

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	=0	=0	=0	=0	1	=0	=0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISAME	LOCAL
1	=1	3.06	=0.	3.06	1.00	=0.	=0	=0

PRECIP DATA

SPFE	P6S	P6	P12	P24	P48	P72	P96
=0.	27.20	102.00	120.00	130.00	=0.	=0.	=0.

LOSS DATA

LOSS	STRKR	STRTL	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
=0	=0.	=0.	1.00	=0.	=0.	1.00	=0.	=0.	=0.	=0.

GIVEN UNIT GRAPH, NUMGN= 1

1155.

UNIT GRAPH TOTALS 1155. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA
STRTQ= 1.00 QRCSN= 1.00 RTIOR= 2.00

END-OF-PERIOD FLOW

AC.FT	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.03	.03	0.	359.	1.01	12.10	73	.46	.46	0.	5483.
1.01	.20	2	.03	.03	0.	359.	1.01	12.20	74	.46	.46	0.	5483.
1.01	.3	3	.03	.03	0.	359.	1.01	12.30	75	.46	.46	0.	5483.
1.01	.4	4	.03	.03	0.	359.	1.01	12.40	76	.46	.46	0.	5483.

SUMMARY OF D SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	345.73	346.10	348.00
STORAGE	7927.	8625.	12240.
OUTFLOW	739.	744.	24536.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	347.20	0.	10691.	9800.	0.	16.00	0.

PMF

APPENDIX B

GEOLOGY OF DAM SITE

The Duck Creek Dam is a unique structure as it consists of a U-shaped levee-type fill which was erected on an almost flat plain with a slight dip to the south. The dam walls were constructed by using local borrow and placing the material into an embankment surrounding three sides of the lake which formed inside of the structure. The surface material underlying the dam and the lake area was used for the embankment and consists of sands, silts and clays. The surface material is underlain by sand which in turn is underlain by non-marine sand and sandy clay.

The dam is located on the braided stream terrace deposits of the Pleistocene. The underlying sand is the alluvium of the Mississippi-Ohio River complex while the basal sand, sandy clay and clay are the McNairy formation of the Cretaceous.
Braided stream terrace deposits consist of material eroded from the uplands to the east of the dam site. The material has been dissected by small streams in the area which coalesce and diverge but generally flow in a parallel direction. As the uplands are covered with a loess deposit the soils in the area have a high silt content.

This dam is located in Seismic Zone 3. Since this dam is located in Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the levee.

Photo 1: Eastern Levee - Looking North from Section "Q"

Photo 2: Eastern Levee - Looking South from Section "Q"

Photo 3: Lakeslope - Eastern Levee - Looking South from Section "Q"

Photo 4: Southern Levee - Looking East to West

Photo 5: Western Levee - Looking North

Photo 6: Spillway in Top of Levee

Photo 7: Spoilbank - Western Levee near Spillway

Photo 8: Drainage Channel East of Pond 1

Photo 9: Culvert Control Structure at Section "Q"

Photo 10: Culvert Outlet at Section "Q"

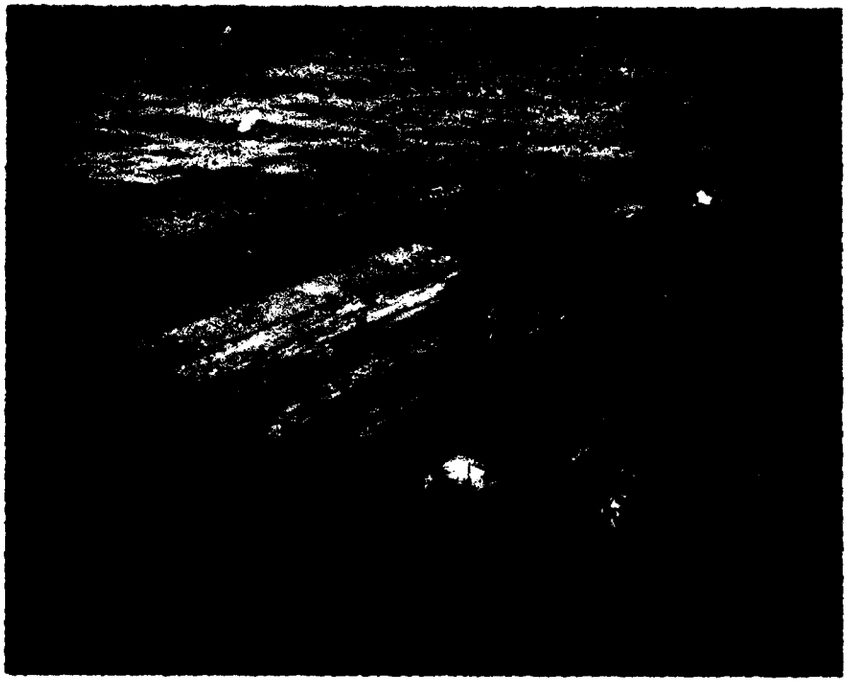

Photo 11: Culvert Control Structure at Section "B"

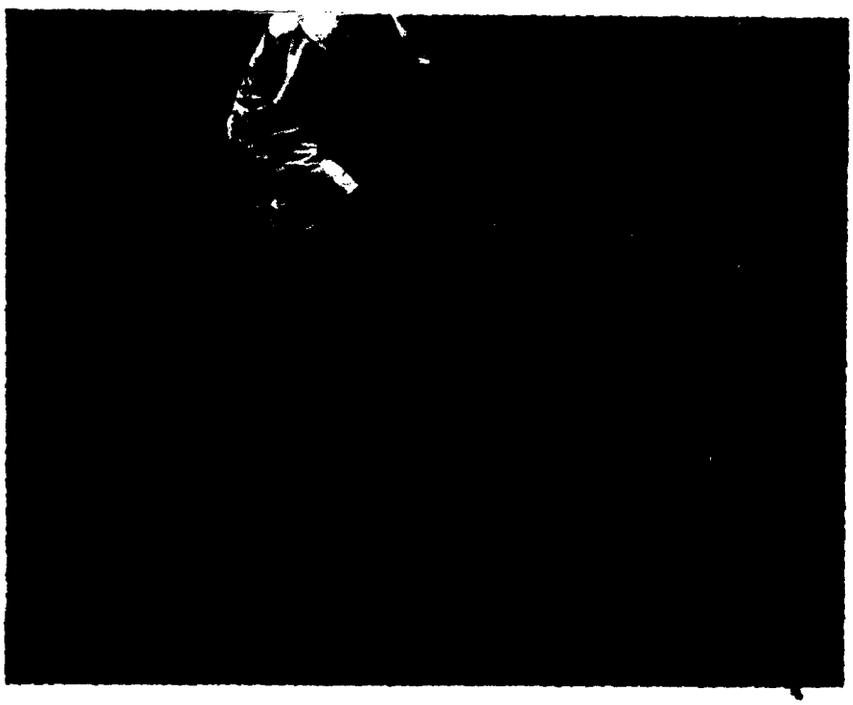

Photo 12: Culvert Outlet at Section "B"

Photo 13: Culvert Control Structure at Section "E"

Photo 14: Culvert Outlet at Section "E"

Photo 15: Sluice Gate at Section "H"

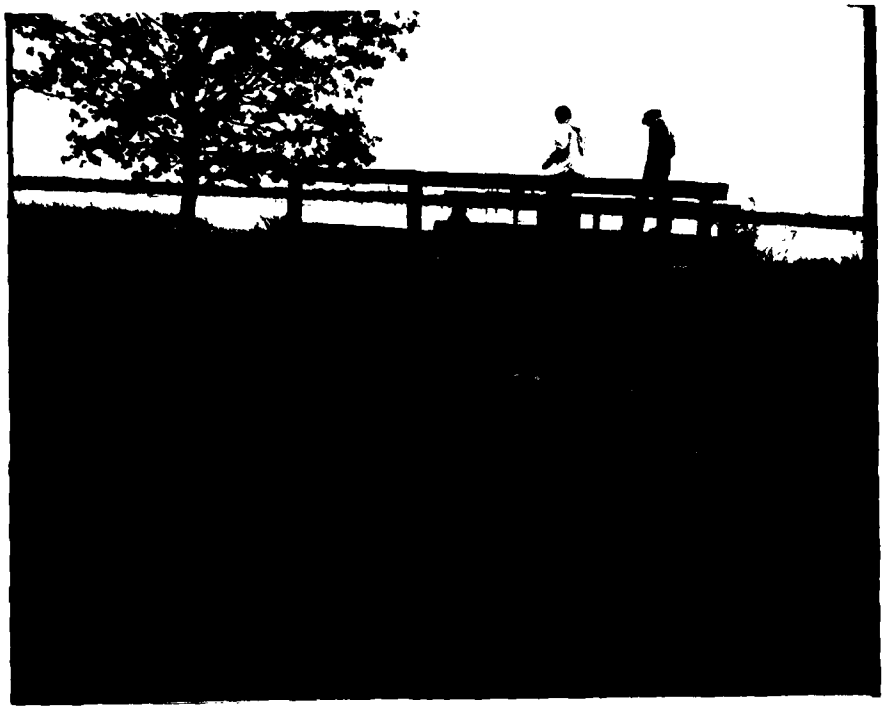

Photo 16: Landside View of Sluice Gate at Section "H"

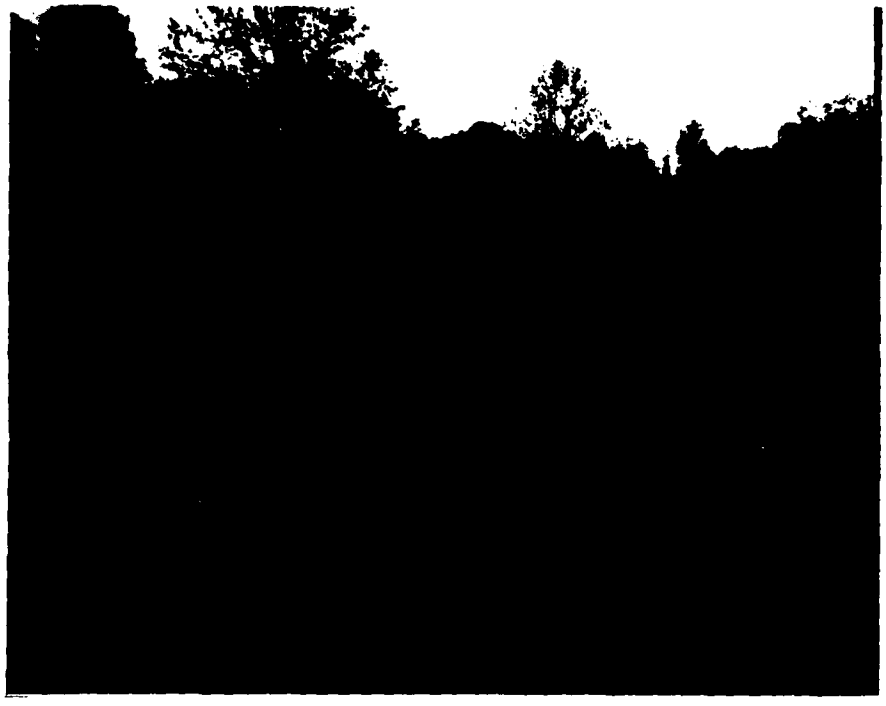

Photo 17: Radial Arm Water Control Structure on Ditch 1

Photo 18: Radial Arm Structure

Photo 19: Downstream of Radial Arm Structure

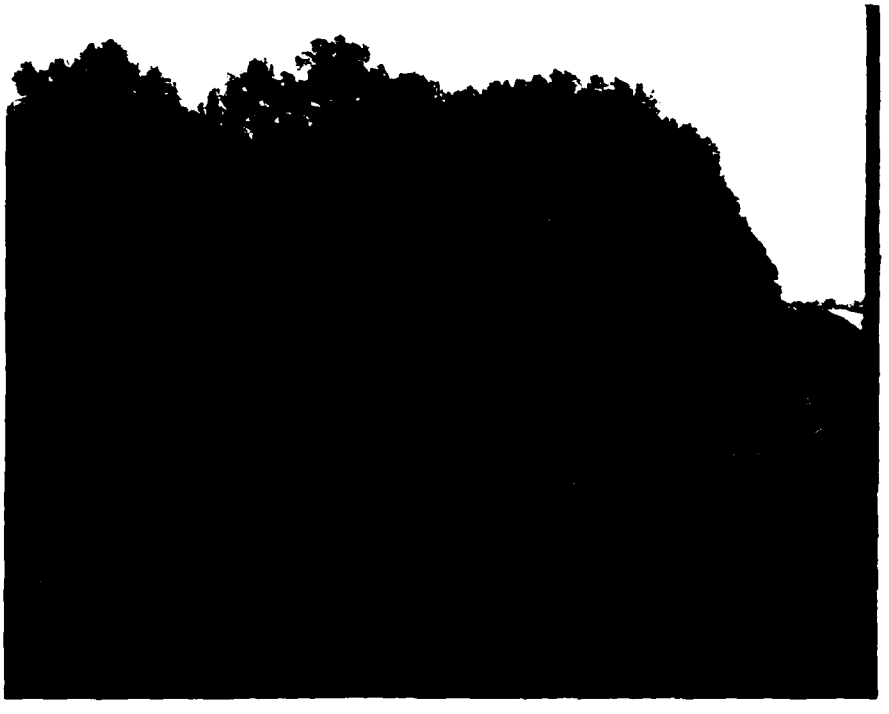

Photo 20: Dwelling Downstream of Duck Creek, Idlewild, MO

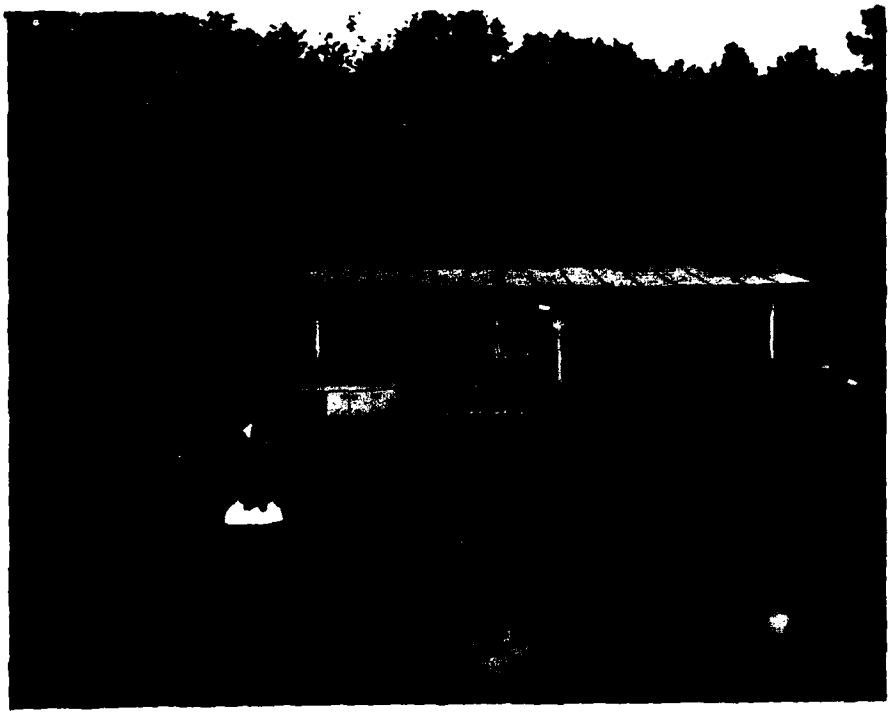

Photo 21: Dwelling Downstream, Idlewild, MO

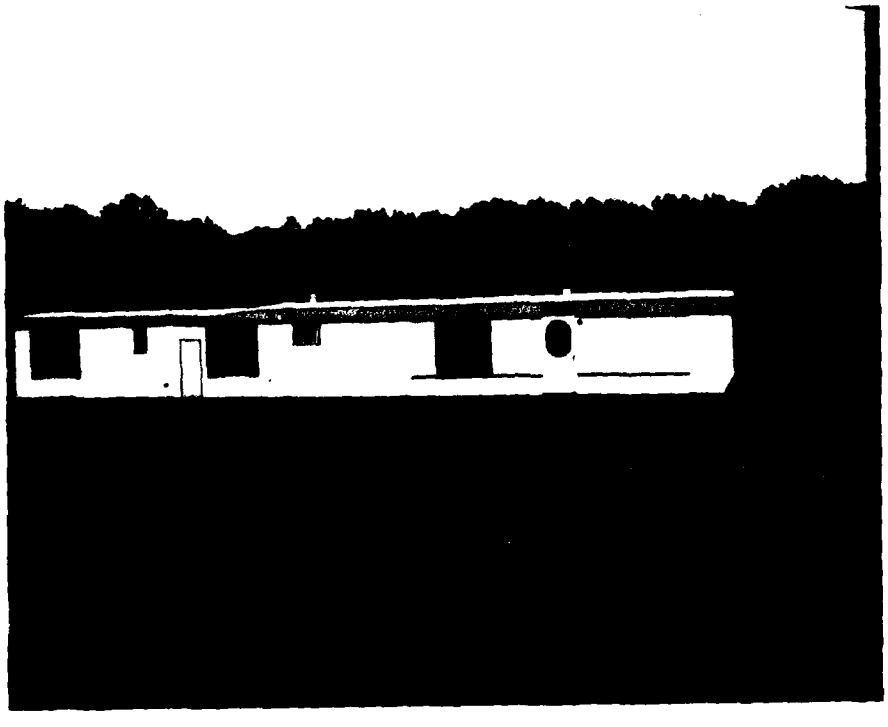

Photo 22: Housetrailer Downstream of Duck Creek, Idlewild, MO

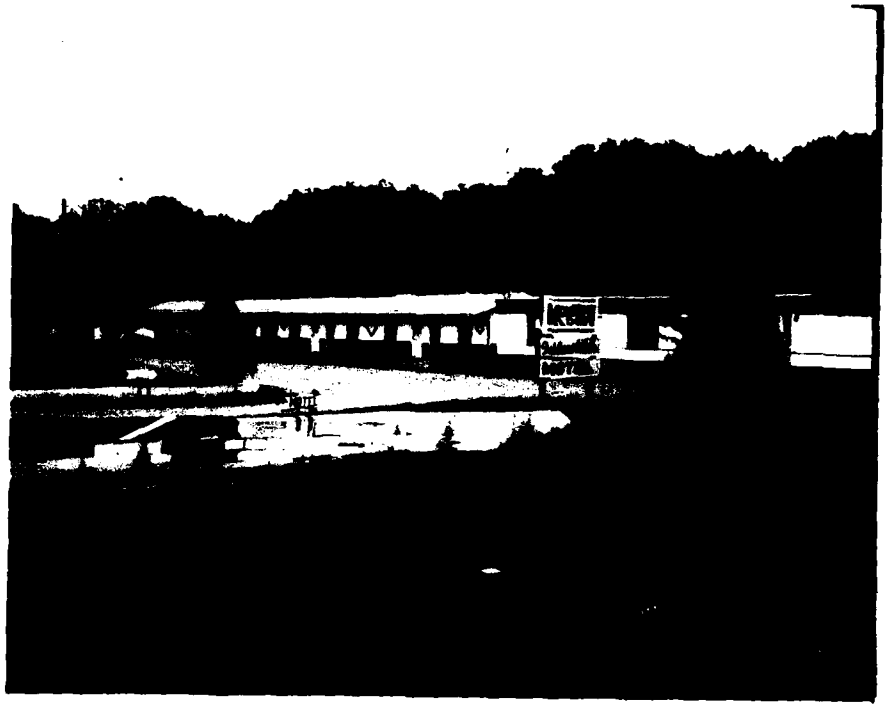

Photo 23: Motel Downstream of Duck Creek, Idlewild, MO

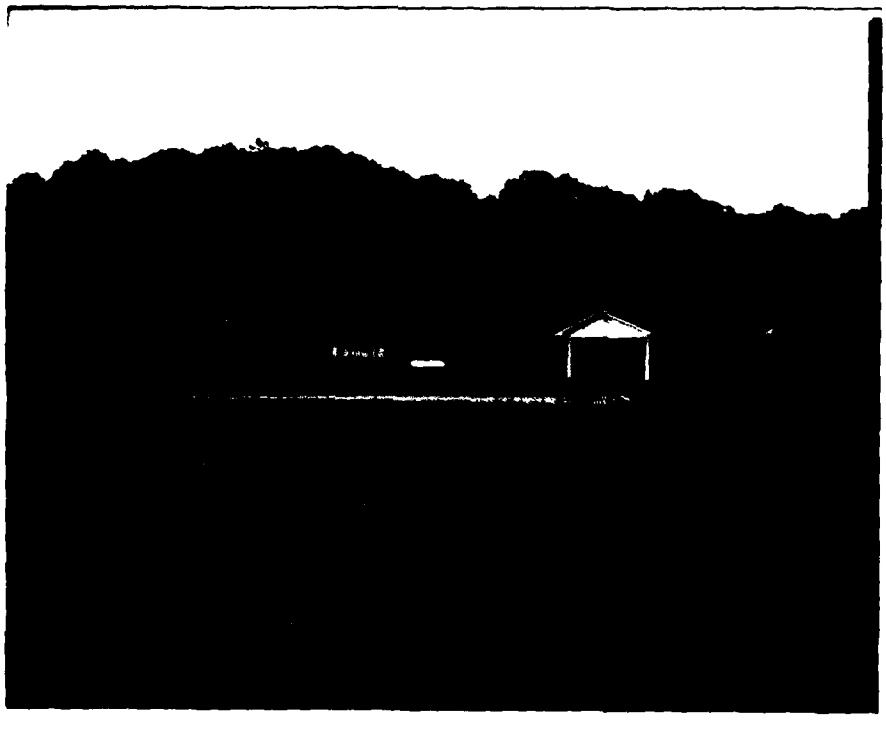

Photo 24: Dwellings Downstream of Duck Creek, Idlewild, MO